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Socio-Economic Impact Assessment of Automated Transit Information Systems Technology

Robert O. Phillips

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Boston MA 02110

March 1984
Final Report

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16. Abstract

This report is the final product of a program to assess the socio-economic impacts of automated transit information system (ATIS) technology deployments on the transit industry's telephone information/marketing function. In the course of this program, three separate deployments were evaluated: The Computerized Customer Information System (CCIS) at the Southern California Rapid Transit District (SCRTD) in Los Angeles; the Automated Information Directory System (AIDS) at the Washington, DC Metropolitan Area Transit Authority (WMATA); and the Transit Information Computer (TIC) at the Metropolitan Transit Commission (MTC) in Minneapolis-St. Paul, which was not part of the UMTA ATIS program. Results of the SCRTD and WMATA evaluations are documented in three companion reports to this volume.* The smaller-scale MTC evaluation is documented in Appendix C of this volume. The purpose of this report is to present common developmental and operational problems encountered at these three deployments for the general information of other transit authorities across the nation that might be interested in assessing the potential of ATIS implementation to improve their telephone information/marketing capabilities.

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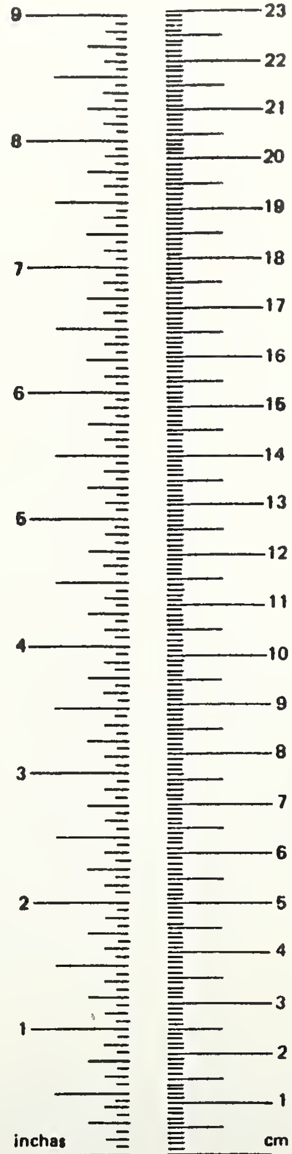
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in. = 2.54 cm (exactly). For other exact conversions and more detail tables see NBS Misc. Publ. 286. Units of Weight and Measures. Price $2.25 SD Catalog No. C13 10 286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	36	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
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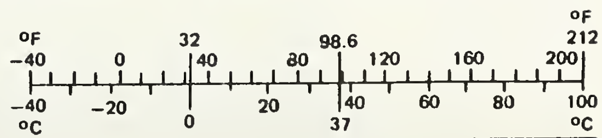
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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PREFACE

This report has been prepared by Wilson Hill Associates, Inc. for the Transportation Systems Center's (TSC) Service Assessment Division in support of the Impact Assessment Program conducted by the Urban Mass Transportation Administration (UMTA) Office of Technical Assistance, Analysis Division. UMTA is cooperating with and supporting the transit industry's efforts to improve the productivity and quality of telephone information/marketing services to the public. The principal focus of this support is on the sponsorship of Automated Transit Information Systems (ATIS) technology demonstrations. This report documents the findings of evaluation activities undertaken by Wilson Hill at three separate ATIS deployments: the Computerized Customer Information System (CCIS) at the Southern California Rapid Transit District (SCRTD) in Los Angeles; the Automated Information Directory System (AIDS) at the Washington, DC Metropolitan Area Transit Authority (WMATA); and the Transit Information Center System (TIC) at the Metropolitan Transit Commission (MTC) in Minneapolis-St. Paul. AIDS and CCIS were deployed as part of the UMTA ATIS development program.

The purpose of this report is to inform the transit marketing community, especially that portion devoted to telephone information, regarding the management decisions and developmental tasks required for the effective automation of transit telephone marketing services. It may also serve as a reference to others more generally interested in the implementation of computer-assisted data retrieval systems.

The evaluations described in this report were conducted under the management of Mr. Robert Furniss and Mr. Robert Phillips, Project Managers for Wilson Hill Associates. Mr. Furniss was Project Manager through February, 1981 when he resigned his position at Wilson Hill. On this date, Mr. Robert Phillips assumed project management responsibilities.

Much gratitude is expressed by the author to those personnel involved in telephone information services at the three transit properties, particularly to Mr. Douglas Anderson and Mrs. Paddie Brennen at SCRTD, Mr. Michael Noonchester and Mrs. Frances Gray at WMATA, and Ms. Kim Johnson and Ms. Carol Armstrong of MTC, for their cooperation and assistance. In addition, special thanks go to Mr. John Durham of UMTA, and Mr. I. Michael Wolfe and Dr. Arthur S. Priver, TSC Contract Monitors, for their encouragement and managerial support.

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A telephone information service is one tool frequently employed by transit authorities as part of their overall public marketing strategy. Such a telephone information service has several distinct advantages as compared with alternative media such as printed service schedules or maps. First, it is easy to use and is accessible to a substantial portion of the transit-riding public. Second, it can be frequently updated to reflect changes in routes and schedules, breakdowns, special services, etc. Finally, and most importantly, it can be personalized to meet the needs of the individual customer.

At most transit authorities, telephone information operators, or agents, employed by the authority have traditionally provided information to callers by referencing large indexed volumes of schedules, headway sheets, maps, route descriptions, etc. located at their work stations. This process can be time-consuming, tedious, and heavily labor-intensive. It is therefore quite costly for transit authorities to maintain a telephone information operation in proportion to consumer demand for this information. In most instances, tradeoffs are made in favor of cost reductions which result in information service shortfalls of 30 percent or more during peak demand periods.

This report, prepared by Wilson Hill Associates, Inc. for the Transportation Systems Center's (TSC) Service Assessment Division, is the final product of an effort to evaluate the impacts of automated transit information system (ATIS) technology on the transit industry's efforts to improve the quality, cost-effectiveness, and productivity of these telephone information/marketing services. The Urban Mass Transportation Administration (UMTA) has over the past eight years been implementing a research and development program

aimed at determining the feasibility of applying state-of-the-art computer technology to the provision of transit information. UMTA has supported three separate proof-of-concept demonstration deployments of ATIS technology, the first two of which were sponsored by the Office of Technical Assistance. These deployments were developed and implemented independently by the Southern California Rapid Transit District (SCRTD) in Los Angeles, the Washington, D.C. Metropolitan Area Transit Authority (WMATA) and the Metropolitan Transit Commission (MTC) in Minneapolis-St. Paul. The SCRTD ATIS is known as the Computerized Customer Information System (CCIS), while the WMATA system is known as the Automated Information Directory System (AIDS) and the MTC system is known as the Transit Information Computer (TIC).

TSC, in support of the UMTA Office of Methods and Support, Analysis Division, has sponsored the evaluation of these three ATIS deployments. Despite their independent development, the systems share a number of common characteristics, and the processes which led to their implementation included a variety of similar management decisions and development tasks. It is this common base of experience that forms the focus of this report. In presenting the problems encountered and lessons learned by management at SCRTD, WMATA, and MTC, this report can serve as a valuable reference to other transit properties contemplating the introduction of ATIS technology to their telephone information/marketing operations.

The application of computer logic, memory and speed to the data retrieval function raises the potential for improving an information operator's job in a variety of ways. These improvements can produce benefits not only for the agents, but also for the transit authority management and the general public as well. Among these hypothesized benefits are:

- improved productivity in terms of agent calls per hour due to faster data retrieval;

- increased reliability and consistency of agent responses;
- a reduction in training time for new agents;
- improved capability to rapidly incorporate changes in transit agent reference data;
- enhancement of the agent's overall job satisfaction;
- expanded capability to gather statistics concerning individual agent and Information Section performance; and
- use of the transit system data base by other departments as a planning source.

Computer assisted data retrieval changes the information agent's job in a number of fundamental ways. ATIS operation involves an agent's retrieving desired information through the use of a remote interactive computer terminal located at the agent's work station. The system is activated by the agent's entering caller query data on the keyboard and selecting the proper functions to produce the desired response. Following processing, which takes a matter of seconds, the computer responds with several appropriate alternatives. The agent then evaluates these responses in light of the query and selects the one best suited to the caller's needs.

In order to evaluate the impacts of ATIS technology on the three agencies, a wealth of socio-economic data were gathered. Some quantitative data, including demand and productivity statistics, were collected automatically by the ATIS systems themselves. Qualitative data, including agent and management opinions, were obtained through opinion surveys, questionnaires, and personal interviews. A controlled experiment was performed at the SCRTD in which the performances of agents using ATIS-assisted data retrieval were compared with the performances of agents using traditional manual methods.

Based on the diverse data gathered at the three authorities, a number of conclusions concerning the impacts of ATIS technology can be substantiated. Among these conclusions are:

- ATIS technology can and does work. It is indeed a viable alternative to traditional manual data retrieval methods. Experimental results showed that agents using the ATIS produced responses that were more accurate in less time than their counterparts using manual retrieval. While a number of problems were encountered during system implementation and the transition from manual to automated operation took longer than expected at the three sites, the general attitude towards ATIS operation today is one of unqualified enthusiasm. The problems encountered were thus not insurmountable; in fact, they were symptomatic of those obstacles experienced whenever computer technology is substituted for skilled labor.
- Effective ATIS implementation must be predicated on the full confidence and support of its intended users, the telephone information agents. The establishment of mechanisms to reinforce agent confidence must occur very early in the system development process. All such mechanisms must be based on the premise of open dialogue, recognizing the agents' considerable training and experience, and on the understanding that their input is crucial to creating a workable system.
- Anticipated productivity increases (in terms of calls answered per labor-hour) should not be the only rationale for ATIS implementation. While an efficient ATIS can theoretically reduce average total call time by drastically reducing data retrieval time, productivity gains of up to 50% as originally predicted have not been experienced by any of the three deployments evaluated. Rather, these gains have been in the 10% to 15% range.

In practice, experienced manual agents can respond to many calls from memory, eliminating the need for data retrieval altogether. Also, agents using both manual and computer methods occasionally take longer breaks between calls. The implication of these two factors is that increases in agent productivity should not be regarded as an automatic consequence of ATIS implementation. An ATIS, while conducive to increased productivity, does not necessarily cause it. Other management productivity controls and incentives can be equally effective in stimulating productivity increases. For example, at SEPTA in Philadelphia and other locations, an ATIS would be less attractive due to management policy of using retired bus drivers as telephone information agents.

- Data collected during the evaluation regarding training time reductions for new agents was so conflicting as to prevent any general conclusions from being drawn concerning this particular benefit area. It appears as though achievement of this benefit depends to a large extent on the particular features designed into each system.
- While the concepts underlying system functions and features are transferable from one system to the next, an ATIS must necessarily be unique to a certain transit agency. There does not appear to be a likelihood of creating a "generic" ATIS which could be transferred at low cost from one transit agency to another.
- Cost reduction for the telephone information/marketing function is generally considered to be the ultimate justification for ATIS implementation, and significant cost savings have indeed been achieved, especially in the areas of agent training (SCRTD), data base updating (MTC) and agent productivity (WMATA). According to system managers, however, it is in the achievement of the less

tangible benefit areas (enhanced agent satisfaction and improved information accuracy, for example) that the various ATIS deployments evaluated have enjoyed their greatest success.

- Transit officials charged with implementing an ATIS should not assume that achievement of cost and productivity benefits automatically follow from the management decision to implement such a system. In order to eliminate negative agent perceptions and ensure a smooth transition from manual to automated operations, a carefully controlled apparatus for agent input and feedback should be in place and functioning throughout system analysis, specification, design, development, and implementation.
- The cost of developing and implementing a comprehensive ATIS for a large, complex transit authority (one which provides at least itinerary, schedule, route and fare responses) is considerable. The WMATA AIDS system cost almost $1 million; it is estimated that expanding the SCRTD's pilot CCIS systemwide would cost $3 million. Due to its high cost, it appears as though a comprehensive ATIS is appropriate only in the context of a large agency.
- The MTC's TIC system, while it can be termed only a "partial" ATIS in comparison with the SCRTD and WMATA systems since it provides only schedule responses, still produces considerable benefits, especially in terms of increased productivity and centralized data updating. Based on this success, it is evident that even such "partial" ATIS deployments could be appropriate for medium-sized or smaller agencies. It should be noted, however, that deployment of the TIC was preceded by the creation of a comprehensive RUCUS data base. The TIC data base was essentially a low-cost reformatting of this RUCUS data. It remains to be seen whether there is a lower limit to the size of a transit agency

where automation of data retrieval for telephone information purposes would be cost-effective. Perhaps low-cost microcomputer technology, or automated voice response systems which eliminate human operators, could be the solution for data retrieval in such small systems. At any rate, it is evident that small (200 buses or less) agencies cannot afford and probably do not need the sophistication of a comprehensive ATIS.

- At each of the three properties evaluated, management is only just beginning to realize the potential significance of system data bases (particularly the geographic data bases at SCRTD and WMATA) as a valuable resource, not only to other transit property departments but to the entire metropolitan area. These data bases could be leased out to various planning organizations for ridesharing/carpool programs, traveler information provision at transportation terminals where the demand for this information is high, calculation of fair service assessments for local governments, etc. The transit agency can actually help pay for system implementation through such spinoff uses. The overall financial justification for system creation is therefore far greater than merely producing cost savings within the transit agency's telephone information department.

1.0 INTRODUCTION

This report is the final product of a program to assess the impacts of Automated Transit Information System (ATIS) technology on the transit industry's efforts to improve the quality, productivity and cost-effectiveness of telephone information/marketing services provided to the public. It was prepared by Wilson Hill Associates, Inc. for the Transportation Systems Center's (TSC), Service Assessment Division. The TSC, acting in support of the Urban Mass Transportation Administration (UMTA) Office of Technical Assistance, Office of Methods and Support, Analysis Division, has sponsored the evaluations of three separate UMTA-funded ATIS deployments. These deployments were developed independently by the Southern California Rapid Transit District (SCRTD) in Los Angeles, the Washington, DC Metropolitan Area Transit Authority (WMATA) and the Metropolitan Transit Commission (MTC) in Minneapolis-St. Paul. The ATIS implemented at WMATA is known as the Automated Information Directory System (AIDS), while the SCRTD system is known as the Computerized Customer Information System (CCIS), and the MTC system is called the Transit Information Computer (TIC) System. CCIS and AIDS were funded by the Office of Technical Assistance as part of the ATIS development program.

This report synthesizes the results of evaluation efforts undertaken by Wilson Hill at each of the three ATIS demonstrations. The evaluations conducted at SCRTD and WMATA are the subject of three separate companion reports.* These results, as well as those of the comparatively smaller-scale evaluation of the MTC deployment are presented in Appendices A, B, and C of this report.

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* These reports are:

Robert O. Phillips, The CCIS Experiment: Comparing Transit Information Retrieval Modes at the Southern California Rapid Transit District (SCRTD): Final Report, Mar., 1983, DOT-TSC-UMTA-84-2.

The three ATIS demonstrations examined in the UMTA/TSC-sponsored evaluation program differ considerably in terms of hardware configurations, software design, data base contents, and extent of geographical coverage. They all, however, share a common purpose: to assist transit system telephone information operators in performing their jobs. Differences between the systems studied are largely attributable to divergent management styles and philosophies prevalent at the three agencies. Despite their independent development, the three systems share a number of common characteristics, and the processes which led to their creation included a variety of similar management decisions and development tasks. Similar problems were encountered and similar solutions to these problems were attempted.

It is this common base of experience in ATIS development and implementation that forms the focus of this report. In presenting the common lessons learned by management at SCRTD, WMATA, and MTC, this report can serve as a valuable reference for other transit agencies contemplating the potential application of ATIS technology to their telephone information/marketing operations. The purpose of this report is therefore to inform the transit marketing community, especially that segment devoted to telephone information services, regarding management decisions and developmental tasks necessary to effective ATIS deployment and implementation. It may also serve as a reference for others more generally interested in

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Robert O. Phillips, A Socio-Economic Impact Assessment of the Computerized Customer Information Systems (CCIS) at the Southern California Rapid Transit District (SCRTD): Final Report, June 1983, Report No. DOT-TSC-UMTA-83-26.

Robert O. Phillips, A Socio-Economic Impact Assessment of the Automated Information Directory System (AIDS) at the Washington, DC Metropolitan Area Transit Authority (WMATA): Final Report, April 1983, Report No. DOT-TSC-UMTA-83-20.

computer-assisted data retrieval systems. Detailed descriptions of evaluation results at the three agencies visited are not included in this report; for these data, the reader is referred to the three companion evaluation reports and Appendices A, B, and C of this report.

The remainder of this report is divided into 12 sections. Sections 2 and 3 describe the role of telephone information in transit marketing and characteristics of traditional manual information center operations. The next two sections (4 and 5) show the motivation for the development of ATIS technology and describe the intended benefits of ATIS implementation. Section 6 describes the ATIS development program sponsored by the Office of Technology Development and Deployment at UMTA. Section 7 describes the changes in traditional information center operations resulting from ATIS deployment. Section 8 discusses preliminary tasks necessary to ATIS development. Section 9 provides some suggestions, based on the three ATIS deployments evaluated, as to the actions and decisions required for an effective transition from manual to automated operations. Section 10 describes the range of automation technologies currently available to transit information center operations. Section 11 presents an accounting of the costs underlying ATIS development and implementation. Section 12 discusses the achievement of intended ATIS implementation benefits, presented in Section 5, as observed in the three systems analyzed. Finally, Section 13 presents general conclusions concerning the overall results of applying ATIS technology and suggests several areas for potential future research and development work in the ATIS field.

2.0 THE ROLE OF TELEPHONE INFORMATION IN TRANSIT MARKETING

Transit agencies have at their disposal a variety of media for marketing their services to the general public. Among these are printed schedules and maps, radio, television and newspaper advertising, and telephone information disseminated from a central office. As compared with other media, a telephone information service has several distinct advantages. First, it is readily accessible to a substantial fraction of the transit-riding public. Second, it can be easily updated to reflect changes in service. Third, and most important, it can be personalized to suit demands of the individual customer. For those customers who do not possess printed transit schedules or maps, calling the transit telephone information service is a convenient method of learning how to make a particular trip via transit. Even those customers who possess printed transit schedules or maps often find it helpful to call such a service in order to interpret or verify information. A marketing publication for one transit agency emphasizes these flexible characteristics:

"For every bus route, there is a free pocket-sized schedule that tells you when and where to catch a bus. If you don't have a pocket schedule, just call (the information number) and an information representative will be glad to assist you. Simply tell the operator (1) where you are (2) where you are going and (3) what time you would like to leave or arrive. It's that simple!"*

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* Metropolitan Transit Commission, <u>Twin Cities Transit Guide</u> (Minneapolis: November, 1982)

Thus, maintaining an efficient telephone information service is a particularly effective method for a transit agency to influence the public's choice of transportation mode. Particularly in urban areas having complex transit systems in terms of size, number of routes, or alternative modes, telephone information is generally employed to overcome a major barrier to transit use: public apprehension of "getting lost" on transit. Such a service, if it is accessible and responsive, enhances the agency's public image as well as serving as a useful and helpful means of getting from one place to another.

3.0 TRADITIONAL TRANSIT INFORMATION CENTER CHARACTERISTICS

3.1 THE TRADITIONAL INFORMATION AGENT'S JOB

In a typical transit system telephone information center, system employees (who in this report will be referred to as "agents") answer inquiries from prospective transit riders about schedules, routes, particular trip itineraries, fares, etc. Traditionally, the agent receives the caller's inquiry, and abbreviates it on scratch paper, usually while assisting the caller in stating it as exactly as possible. Once the inquiry is understood, the agent manually consults route maps or other printed information located at the agent's work station, piecing together the information desired. Once an appropriate response has been retrieved, it is provided to the caller.

Although calls vary widely in terms of information requested and data retrieval tasks required, a typical call lasts approximately three minutes: one minute for the caller's request to be made and understood, one minute for data retrieval, and one minute for the agent's response. This three-step process is repeated many times in the course of an agent's normal workday.

3.2 THE TRADITIONAL TRANSIT INFORMATION CENTER

Depending on the extent of caller demand and the size of the transit agency the typical transit information center contains work stations for up to 50 information agents, each equipped with its own telephone connection and set of hard-copy reference data. These data, consisting of schedules and headway sheets, can run into the thousands of pages in a complex transit system, and are kept in large indexed binders. Wall maps of the service area, marked with routes and other features, are centrally located for easy reference. Agents also often keep smaller maps at their work stations. Carpeting, partitions, and acoustical tile are generally provided to keep background noise to a minimum.

3.3 PROBLEMS WITH THE TRADITIONAL APPROACH TO TRANSIT TELEPHONE INFORMATION

The traditional approach to transit telephone information center operations, as described above, contains several inherent weaknesses. The major drawback to this manual approach is that it is heavily labor-intensive. For a large segment of the transit-riding public, calling the telephone information service represents the only form of personal contact with transit authority personnel except for vehicle operators. Information agents, as the first point of contact, must therefore develop a wide range of skills to effectively serve the authority's public image. They must be able to:

- listen attentively to repeated caller requests;
- remain courteous and pleasant, even to impatient, confused, or even angry or abusive callers;
- recognize all landmarks, place names, and addresses for even minor streets within the authority's service area;
- read maps and possess a strong sense of direction;
- make effective use of service schedules, headway sheets, and other printed reference data;
- select appropriate itineraries, based on origin and destination information supplied by callers and on their own detailed knowledge of alternative service options operated by the authority;
- provide clear, concise instructions to callers and remain prepared to repeat them if the caller should not understand; and
- enunciate clearly and distinctly at all times.

In order to master all these skill areas, new agents are subjected to rigorous training by the authority. This training, which generally lasts from six to ten weeks, emphasizes intensive agent memorization of transit service and local geographic characteristics, as well as interpersonal

communications skills development and practice. Agent trainees are instructed in the effective use of reference data and in the projection of an image of reliability for the authority. Even after this intensive training period, it takes the average agent an additional six to eight months of experience handling "live" calls before full proficiency is developed.

From the above descriptions, it is evident that the transit authority devotes a considerable investment to equipment, training, and labor for each information agent in its work force. It is therefore quite costly for most authorities to maintain a telephone information operation in proportion to local consumer demand for this information. This economic supply-and-demand problem is attenuated by the fact that consumer demand is not constant but tends to vary widely depending on the time of day and even the day of the week. In most instances, transit agencies make tradeoffs between cost and demand which result in service shortfalls of 30% or more in peak caller demand periods.

Because consumer demand often outstrips the level of service provided, agents are under constant pressure from management to work as rapidly and steadily as possible, using reference materials quickly and keeping break time between calls to a minimum. The number of calls which an agent handles per hour is monitored closely by management and compared with established productivity standards and comparable statistics for other agents. In their training, agents are given considerable practice in call handling techniques in order to keep customer request and agent response phases of their calls to a minimum.

Another problem inherent in the traditional approach to transit telephone information is that printed schedules and headway data used constantly by agents as references become obsolete almost as soon as they are printed. In most large transit authorities, major schedule changes occur every

three or four months, and minor changes happen almost daily. In order to ensure that information being given out by agents is indeed accurate, printed copy must be modified or annotated to reflect these changes, and considerable labor must be invested in this updating process.

4.0 THE POTENTIAL FOR AUTOMATION OF AGENT DATA RETRIEVAL FUNCTIONS

Recent advances in computer technology have raised the potential for the cost-effective automation of the data retrieval portion of the telephone information agent's job. As discussed above, data retrieval accounts for approximately one-third of average agent work time under traditional transit telephone operations. Certain aspects of agent data retrieval functions lend themselves well to computer applications. First, they are highly repetitive; a very large percentage of caller inquiries can be broken down into four or five distinct call types, each requiring agent consultation of certain specific data types. Thus, programming the computer for data retrieval is a relatively manageable task of duplicating agent behavior elicited by a relatively limited number of distinct call types. Second, these data retrieval functions require a high degree of agent familiarity with service area geography and transit system characteristics. These characteristics can be mapped onto a grid system and stored as digitized coordinates in the memory of a computer. Third, agent functions often involve optimization of response data to conform to limitations placed on certain trip parameters by the caller. For example, the caller might want to minimize total travel time, fares required, the number of transfers required, walking distance from stop to destination, etc. The logic underlying agent response selection in view of these caller-stated limitations can be translated into comparison/optimizing computer routines in a very straightforward manner. Fourth, it is very important that agent data retrieval exhibit a high degree of consistency. While human error may introduce a certain amount of variability in agent responses, machine logic ensures that the same inquiry will elicit the same computer response every time. Finally, due to high public demand for their services, agents must work as quickly

and efficiently as possible in retrieving data. The highspeed calculating capabilities of a computer are thus particularly appropriate in this application. Automated processing of a given caller request will involve a much more thorough investigation of alternative responses than time limitations would permit using traditional manual retrieval methods. Aside from a relatively small percentage of calls in which more experienced agents are able to answer inquiries "off the top of their heads" or very rapidly look up data, automated retrieval is much faster than manual consultation of reference materials. The data retrieval phase, which takes a minute on average in manual operations, can be reduced to 10 seconds or less. For detailed inquiries involving multiple-transfer trips, overall call time can be reduced by well over 100%.

5.0 POTENTIAL ATIS IMPLEMENTATION BENEFITS

Automation of data retrieval would thus appear to be a technically feasible means of solving several of the problems inherent in traditional manual transit telephone information operations. Potential benefits to the transit authority and the general public achievable through automation of a transit information center include the following:

- Agent Productivity: The reduction in data retrieval time achievable through faster computer processing should make it possible for the average agent to handle an increased number of caller inquiries per hour. Thus, the productivity of each agent would be increased, and the level of service provided to the public would rise without the authority's incurring the expense of hiring and training additional agents.

- Response Accuracy and Consistency: With centralized updating of the reference data base available through the computer, quality control over the accuracy of agent responses is much easier to maintain than it is under the traditional manual system of multiple hard-copy references. Even novice agents, provided they are well-trained in manipulation of computer functions, can produce the same responses as their most experienced counterparts. The authority's goal of 100% accuracy in agent responses would therefore be much more achievable under computer operation. In addition, consistency of agent-supplied information would be enhanced, since programming logic would ensure that the same request always elicited the same computer response.

- Agent Training: Reliance on the considerable data storage capabilities of the computer could reduce greatly the quantity of information concerning transit system routes and local geographic characteristics which agents need memorize in their initial training; this information would be stored in the computer's, rather than the agent's, memory. As a result, the overall training time for agents would be reduced.

- Updating of Data Base: Since only a simple modification of a single computer file accessible to all agents would be required to reflect a change in service or schedules, the need for constant re-printing or annotating of hard-copy data to maintain accuracy would be eliminated. In fact, hard-copy reference data would no longer be necessary except as a backup in case of computer breakdowns.

- Agent Job Satisfaction: As a result of learning to use state-of-the-art computer technology which eliminates many of the more tedious aspects of their jobs, the general levels of job satisfaction and working attitudes of information agents would be expected to improve following ATIS implementation.

- Data Collection: The computer's inherent data storage capabilities would be exploited in an automated information center to gather statistics concerning agent and center operations, producing performance reports on a variety of different variables considered useful to management, including agent productivity, etc.

- Integration With Other Users: The data bases used as an integral part of the ATIS could prove a valuable source of information for local government agencies or other transit system departments such as those dealing with route planning, stop locations, and service schedules.

6.0 THE UMTA ATIS DEVELOPMENT PROGRAM

Over the past decade, UMTA has been cooperating with the transit industry's efforts to improve telephone marketing functions through its Office of Methods and Support. This cooperation has been provided through sponsorship of research work in this area and through eventual UMTA funding for development of demonstration systems. With this automated transit information system (ATIS) program, UMTA has sought to determine the feasibility of applying state-of-the-art computer technology to the provision of transit information. The overall objectives of the UMTA program are to reduce costs, increase productivity, and improve the level of service provided to the public.

6.1 EARLY ATIS RESEARCH AND DEVELOPMENT EFFORTS

When on-line passenger routing and information systems were introduced by the major airlines in the 1960's, these systems were viewed with considerable interest by transit marketing officials. The demonstrated potential of the airline systems to increase operator productivity and cut overall public information system costs were of particular interest to these transit officials. In order to successfully apply the principles of these airline systems in a transit environment, however, certain fundamental problems had to be overcome.

Because a large number of transit information calls involve locations of trip origins or destinations or both, a current street address directory is a required segment of the data base supporting any transit information system.

Digitizing individual street addresses for an entire metropolitan area on a coordinate reference network requires a very small unit grid element, no larger than 20 to 25 feet on a side. Use of larger elements would "lose" street addresses of houses on smaller lots. Such a fine grid implies an extremely large address data base. For example, digitizing the entire Washington, D.C. service area required creation of a coordinate grid containing over 30 million data coordinates! Such a large data base carries with it the necessity for considerable computer storage capacity if rapid retrieval, comparable to manual agent retrieval, is deemed desirable.

Another major development problem was that of searching out the optimum route between origin and destination for transit callers. Itinerary calls ("how do I get from Point A to Point B?") comprise approximately 40% to 70% of all transit information requests. In a complex transit network, a passenger may have numerous alternative choices for making a trip via transit. The ATIS must somehow recognize all feasible trips, compare them against each other in terms of given criteria, and select the "optimal" choice based on these criteria. Thus, ATIS software must be based on "route-finding" algorithms. Since travel time is generally the optimizing factor for most transit riders, the ATIS data base must also contain a complete description of all transit service routes digitized on the coordinate grid of the address directory, as well as a listing of schedules and travel times for each route. Development of software for these "route-finding" algorithms was another major early stumbling block to ATIS development. Programs had to mimic the thought processes of information agents,

rejecting out of hand almost all available route data and selecting only those routes nearest the origin and destination and most likely to be useful for construction and comparison of possible itineraries. Due to its high speed calculating capacity, a computer can compare a much greater number of potential itineraries than can an information agent in a given time period. The typical trained information agent can, however, usually arrive at the optimal solution with printed references in a minute or less.

The UMTA ATIS program began in 1973 as a set of studies to determine the feasibility of developing route-finding algorithms for large transit networks that could operate within this time constraint. Studies done at the National Bureau of Standards and by independent consultants indicated that, while small service area ATIS applications might be feasible, computer processing requirements for selecting appropriate itineraries increased geometrically with the size of the transit service area. These studies concluded there were no existing computer systems with sufficient capacity to handle large transit service areas in a responsive manner; in other words, the fastest computer retrieval speeds achievable for large systems were not comparable to those already achieved by agents using manual retrieval methods.

6.2 THE SANTA MONICA PARIS DEMONSTRATION

Both the data-storage and route-finding algorithm problems were substantially solved by 1974. Advances in the storage capabilities of lower-cost mini-computers as well as the development of far more efficient route-finding algorithms set the stage for the first successful transit

ATIS demonstration in 1974 at the privately-held Santa Monica Bus Lines in Southern California by System Development Corporation (SDC), a local computer firm. An SDC employee had focused his doctoral thesis on attempting to solve the algorithmic problem of computing transit itineraries for large service areas within a demand-responsive time frame. This route-finding research was expanded into a corporate venture after its capabilities were proven in the laboratory. For the Santa Monica demonstration, SDC developed a proprietary package called PARIS (PAssenger Routing Information System).

While this demonstration was largely cosmetic since the Santa Monica bus system was neither large nor complex, it was significant in that the principles of ATIS had been successfully integrated into a working system and implemented in a real-world setting. The Santa Monica demonstrations drew considerable attention from other transit properties and from UMTA.

6.3 THE WMATA AND SCRTD DEMONSTRATIONS

In 1975, UMTA envisioned developing a large-scale computer model of a hypothetical transit network on which to test and refine the concepts demonstrated in Santa Monica by SDC on more complex systems. At this point, however, WMATA's Office of Marketing let it be known that implementation of a computer system to aid transit telephone operators was being very seriously considered. Provided with an ideal real-world situation in which to conduct administration of an ATIS, UMTA moved quickly to support the WMATA project. In late 1976, a $435,000 R&D grant was awarded to WMATA to develop and demonstrate ATIS technology. The first phase of this effort was successful and culminated in the production of a detailed

specification for an ATIS at WMATA. In 1978, WMATA awarded a contract for a turnkey installation of an ATIS. The development of a systemwide WMATA ATIS proceeded forthwith, as is described below in Section 9.0.

Subsequent to the WMATA award, the Southern California Rapid Transit District (SCRTD) also applied to UMTA for funding to develop an ATIS prototype. This SCRTD demonstration was also supported by UMTA for several reasons:

- The SCRTD's ATIS was considered a pilot demonstration and was limited to the San Fernando Valley, only a small portion of the SCRTD's service area;
- Because of this limited geographic coverage, funding amounts were smaller ($150,000) and overall implementation time was shorter than the WMATA demonstration;
- The SCRTD demonstration provided an alternative approach for developing an ATIS since it relied on a time-sharing mainframe computer configuration in contrast to the much more expensive dual dedicated minicomputer configuration specified for the WMATA ATIS; and
- Successful demonstration of the ATIS prototype would be likely to lead to future expansion of the system to include the entire SCRTD service area.

SCRTD system development is also described below in Section 9.0.

6.4 THE MTC DEMONSTRATION

Under a program separate from the WMATA and SCRTD efforts, UMTA has provided funding for a third ATIS demonstration

at the Metropolitan Transit Commission in Minneapolis-St. Paul. The MTC effort began as a search for alternatives to hard-copy data storage, as maintaining updated manual references for agents was proving to be very expensive to the Commission. Marketing officials considered the benefits of converting to microfiche systems, but soon concluded that these systems, while capable of storing more information than hard copy references of similar physical dimensions, incorporated many of the disadvantages associated with hard-copy updating. As a result, MTC management opted for a computerized data retrieval system.

The MTC's automated retrieval system, developed from 1978-1980, differs from the WMATA and SCRTD systems in a number of key areas. First, it specifically lacks a geographic data base and therefore has no capability to construct itineraries. To provide itinerary data, the MTC still relies on an intensive agent training program. On the other hand, the MTC system does not require continuous updating to reflect local land development projects and other geographic changes. Data retrieved by the system are almost entirely schedule-related and are generated by a relatively low-cost reformatting of RUCUS system data made available by the MTC's Scheduling Department. Thus, while it provides considerable data retrieval power to information agents, the MTC system is not nearly so comprehensive as the SCRTD and WMATA systems with their route-finding capabilities.

6.5 SUMMARY

From the above discussion, it can be inferred that the UMTA ATIS development program, in contrast to many

such programs, has focused on proof-of-concept demonstrations in real-world situations rather than on more thoeretical research activities. The evaluations of these demonstrations, also sponsored under the UMTA program, are intended to provide other interested properties with information on their benefits and costs, and also to diminish duplication of errors in system development.

In the future, the UMTA ATIS Program may seek to make computerized retrieval available directly to non-trained users (i.e., the general public) through a touch-sensitive CRT and hard-copy output device to be located at a major transportation terminal such as an airport or train station. By selecting several user-friendly functions, passengers using this terminal will be provided with up-to-date advice as to the appropriate mode for continuing their journeys to their ultimate destinations. Installation of such a system is expected to provide better inter-modal integration, which should mean lower congestion and overall transportation costs to the city involved.

7.0 CHANGES TO TRANSIT TELEPHONE INFORMATION OPERATIONS CAUSED BY ATIS IMPLEMENTATION

Effective implementation of an ATIS in a transit telephone information environment will necessitate the undertaking and acceptance of a number of changes to the traditional manual approach to information provision as described above in Section 3. These changes affect not only the work habits and job skills of individual operators, but also the manner in which overall information center operations are conducted. Some of the more important of these changes are discussed below.

7.1 AGENT JOB CHANGES DUE TO ATIS IMPLEMENTATION

The traditional transit telephone information agent's job is profoundly affected by ATIS implementation. While the telephone interface with the caller remains largely the same as before, the data retrieval aspects of the agent's job are changed completely. ATIS operation involves an agent receiving queries from a caller and retrieving desired information through use of a remote interactive computer terminal located at the agent's work position. The system is activated when query data are entered on the terminal keyboard by the agent. The query is then processed in the computer through preprogrammed routines selected by the agent through manipulation of terminal function keys. These routines reference the geographic and transit data bases (addresses, fares, routes, schedules, etc.) and optimize certain caller-stated trip parameters (travel time, transfers, fare, walking distances, etc.) through route-finding algorithms and comparison of potentially

feasible routing alternatives. Following processing, which is accomplished in a matter of seconds, the most appropriate response (more than one response is generally given) considering caller-stated limitations is displayed on a cathode ray tube (CRT) located above the agent's keyboard. This display is then evaluated by the agent and the appropriate information supplied to the caller.

Although the tedious physical aspects of manual data retrieval (leafing through heavy volumes) are eliminated by ATIS operation, certain new job skills and habits are required. A basic job change, of course, is that an agent must possess at least rudimentary typing skills in order to enter caller-supplied input data quickly and accurately on the terminal keyboard.

Since the computer will accept only certain specific input types (origins and destinations, departure or arrival times, etc.) and must have this information in a complete and "correct" (i.e., recognizable) format, the ATIS agent is required to obtain much more precise inquiry data from the caller than was necessary under manual operations. Extracting these precise data from callers quickly and efficiently is one job change that must be mastered by the agent if ATIS operation is indeed to increase overall call productivity.

ATIS operators must remain prepared for system "error" messages; even if all system format requirements are met by an agent, caller-supplied input data may occasionally be incorrect. These system errors can be a source of considerable frustration for ATIS agents, since they slow down call productivity, require new computer transactions, and are often caused by "minor"

input mistakes such as misspelled addresses. The frequency of these errors for each agent can easily be monitored by information center management under ATIS operation.

Another aspect of ATIS operation which requires a change in operator working habits is the fact that the computer takes a certain amount of time, however brief, to respond to agent input once a processing transaction is started. During this time, an agent can only sit and wait for the response to appear on the terminal CRT screen. Under normal operations, an agent is under pressure to work constantly and without interruption. For some agents, waiting for responses during this pause in routine created by computer retrieval time can be another source of considerable impatience and frustration, particularly if the system response time is so slow as to be comparable to manual retrieval time for the given transaction. Slow system responses tend to create an attitude of "I should have looked it up manually" on the part of the agent, and discourage ATIS use.

Under ATIS operation, information agents must become as familiar and adept with computer-supplied reference data types as they were with the voluminous manual references. This requires an agent to be constantly aware of all the possible computer transactions available, and to very rapidly select the transaction most appropriate to each call. Usually this job change presents little problem for experienced agents who are quite used to making such rapid judgments.

Another major job change is the abundance of information which an agent can call up on the screen in response to a typical call. Where the time limitations of manual

retrieval usually permitted only a single reference, ATIS operation usually provides between 2 and 4 complete alternative responses for a given agent input. The information agent must be able to rapidly scan these alternatives and choose the one which is optimal for the given call. For obvious reasons, it is usually counterproductive for an agent to supply more than one response to a caller inquiry. ATIS operators must therefore avoid the temptation of responding with all the information at their disposal; responses such as "but then again, you could take this bus..." do not inspire caller confidence in the information received.

7.2 ATIS EFFORTS ON INFORMATION CENTER OPERATIONS

ATIS implementation has several important effects on overall information center operations. The most far-reaching change is in the sheer volume of information which computer storage makes available to information center management concerning each agent's job performance. Under manual operation, each agent's call volume was approximated through random monitoring of calls by supervisors. Under ATIS operation, the computer can compile a complete daily history of agent performance, including total calls answered, average speed of answer, the number of times each processing transaction was used by the agent, the number of input error messages received, the percentage of time spent in data retrieval vs. the percentage spent talking, etc. The computer can also generate compilations of these daily histories into weekly and monthly averages for trend analysis.

Faced with this totally unbiased and unimpeachable record of their performance, agents are given an extra

motivation to perform efficiently. Discipline for inadequate performance becomes much more of a certain prospect for agents who consistently shirk their responsibilities. Discipline becomes easier for management as well, since accurate statistics can be used to substantiate actions taken.

The compiled performance information can also be used by information center management to establish guidelines or goals for center productivity. These goals can be tied to incentive programs for rewarding above-average performance by individuals or teams of agents.

Freed from their traditional roles as maintainers of hard-copy data, information center supervisors under ATIS operation are able to take on the responsibilities for which their positions were actually created: troubleshooting of agent problems as they occur, and assuring the quality of agent responses.

Due to the fact that memorization of large amounts of geographic and transit data is no longer required, information center management is enabled under ATIS operation to select agents from a different overall labor pool than was previously the case under manual operations. Because training for ATIS operation can be accomplished in some transit agencies (See Section 12.3) over a much shorter time frame, management can turn to older employees who were previously unsuited for the rigors of the manual agent training course. These older employees, according to management, are statistically more dependable workers and better-suited to the agent's job.

Because fewer resources are required to train each additional agent under ATIS operation, the transit agency might find it useful to train a number of part-time agents. These agents could fill in gaps in the supply of operators during peak caller demand periods. They could also make center staffing much more responsive to fluctuating caller demand than was the case under manual operations. Finally, they could provide full-time personnel much more flexibility in planning vacations, etc. Unfortunately, however, telephone information operators at most transit agencies are strongly unionized, and the labor unions representing them would probably oppose hiring any part-time employees.

8.0 PRELIMINARY STEPS NECESSARY FOR ATIS DEPLOYMENT

In this Section, four preliminary steps necessary for the deployment of an ATIS, or for that matter any other type of automated system, are described. These steps are feasibility analysis, requirements analysis, system specification, and contractor selection. To highlight general explanations of these project steps, specific experiences from the three deployments evaluated (SCRTD, WMATA, and MTC) are included.

8.1 FEASIBILITY ANALYSIS

The feasibility analysis investigating the usefulness of a proposed automated transit information system must begin with a thorough examination of the existing manual telephone information operation. This examination should include productivity statistics and the extent of calls "lost" during peak demand periods. It should also characterize patterns of caller demand and information center staffing. It should attempt to gain an accurate picture of call type frequency and the extent to which certain manual reference types are used by agents. From complaints received or agent interviews, an attempt should be made to describe the general attitude of the public towards the information currently being provided: Is it useful? Is it enough? Is it accurate? Does it convey the desired image of the transit authority as a helpful public service? The feasibility analysis should scrutinize the attitudes and opinions of agents concerning their jobs: are good agents difficult to retain? Does the expense invested in agent training pay off in competent, professional call management? Or is it lost in rapid job turnover?

The feasibility analysis, once the above observations are complete, should attempt to specify the potential benefits of an automated system. While it is generally customary in such analyses to list these specifications in terms of dollar payoffs, it should be remembered that a number of ATIS implementation benefits (e.g., information accuracy and completeness, agent job satisfaction, etc.) cannot be measured in dollar terms. Benefits that can be estimated in dollar terms include anticipated agent productivity increases, reductions in agent training time, reductions in reference updating staff, etc. These benefits can be described in terms of ranges depending on the extent of anticipated improvement associated with particular ATIS alternatives.

It is quite possible that a system feasibility analysis could reach a negative conclusion regarding ATIS implementation. For example, in a small transit system where agents respond to 90% of calls from memory, computerized retrieval would be of little value, and might actually slow down overall agent productivity.

8.2 REQUIREMENTS ANALYSIS

If the system feasibility analysis proves to be positive enough to warrant further system development, the next step to be undertaken is the requirements analysis. In this step, data collected in the feasibility analysis is refined to the point where clear statements can be made concerning the desirability of certain improvements to information center operations to be achieved through automation. It is extremely helpful at this stage to secure the suggestions of information agents as to what

types of job improvements would prove to be most helpful. While not all these suggested areas of improvement may be achievable or useful, they provide at least some basis for the development of a rudimentary description of the final configuration of the automated system.

It is at this stage of system development that management goals should be established for desired automation benefits. These goals in turn provide a basis for determining the scope of the system: functions incorporated, storage capacity required, response times considered desirable, etc. A number of constraints to these goals must also come into play in scoping the system; for example, the available project budget might well dictate a certain configuration over a more desirable but higher-priced one.

8.3 SYSTEM SPECIFICATION

The requirements analysis should provide at least a rough description of the eventual system characteristics needed to meet established goals. During the system specification, these characteristics are spelled out in detail. Based on requirements analysis recommendations concerning desired levels of computing power, storage capacity, agent-directed transactions, response time, etc., the system specification will delineate exactly how the system should ultimately perform and how this performance is to be maintained. It is at this stage that management decisions must be made concerning the system's geographic coverage (partial or total), number of terminals supported (a limited number of agents or the entire work force) and the degree of control exercised over computer functions (dedicated or shared).

Management at the three agencies evaluated in the UMTA/TSC program made widely divergent decisions during this system specification stage. For this reason, the three systems bear little or no resemblance to each other. At WMATA, the decision was made to include the entire service area in the geographic data base. All agents were to be affected by system changeover, and a dedicated computer ensured complete control over system processing activities by the Office of Marketing which was implementing the system. In Los Angeles, SCRTD management opted for a much more limited system covering only 300 of the District's 2400-square-miles of service area. The SCRTD system was to drive only seven terminals, or approximately one-fifth of the total agent work stations. In keeping with this limited commitment, the SCRTD chose to use their in-house Data Processing Department's UNIVAC 1106 mainframe computer to support the system. At the MTC in Minneapolis-St. Paul, management decided to implement systemwide coverage for all operators, supported by a dedicated minicomputer. MTC management, however, opted not to include a geographic data base and itinerary response capabilities as part of the system.

In many cases, cost was the overriding factor in these specification decisions. Some, however, were dictated by a desire for closer management control over system functions.

8.4 CONTRACTOR SELECTION

Once the system specification is complete, requests for proposals can be issued for competitive bids on system design and implementation. In order to thoroughly and objectively rate the proposals of prospective bidders,

it is generally useful to convene a screening committee or evaluation board comprised of transit agency officials familiar with both telephone information operations and marketing as well as data processing.

At the SCRTD, the proposal review committee voted on a set of selection criteria, including the following:

- Hire only one system design contractor to do the entire job;
- Accept bids only from contractors who could demonstrate working systems;
- Accord strong emphasis to those contractors who recognized the educational backgrounds and training of the system users (the information agents).
- Route finding algorithms used in system software must be workable and based on proven logic. They should produce an itinerary response for even the most complex questions in a maximum of seven seconds.
- The contractor must have a high level of understanding of UNIVAC equipment (the SCRTD mainframe driving the system) and associated software and terminal hardware requirements.
- The agent training program established by the contractor must show a detailed understanding of agent skills and levels of comprehension (most agents were high school graduates, and a few had completed some college courses).
- The contractor must show detailed knowledge of transit systems, especially bus operations and scheduling.
- A strong commitment must be made by the contractor to provide support <u>after</u> system implementation, especially in problem solving and troubleshooting of agent difficulties as they arise.

At WMATA criteria adopted by the Contract Evaluation Board were quite similar to those of the SCRTD, particularly in the areas of understanding of software development, agent training and followup commitment after implementation. Because the planned systemwide geographic coverage of the WMATA system implied creation of a large data base, emphasis was also given to those contractors who had experience creating and maintaining large data base systems. WMATA officials were also interested in the range of skills represented on the various contractor teams, from "hard" computer programming skills to "soft" communication skills required for effective agent interface. This choice was based on several factors:

- overall understanding of the technical problems involved in system design
- experience with ambulance-dispatching systems which used many innovative design features
- willingness to work with WMATA management and users in refining the final product to ensure maximum usefulness.

At the MTC, the evaluation board was particularly interested in bidders' knowledge and understanding of the RUCUS run-cutting and scheduling system which was to serve as the main source of system data. They also accorded considerable merit to the bidder's knowledge of transit systems and their willingness to cooperate with agents in the implementation process.

At all three agencies, unsuccessful bidders were rejected for a number of reasons:

- deficiencies in agent training programs
- problems with route-finding software

- inadequate knowledge of transit systems
- inability to describe systems in understandable terms
- inadequate provisions for continuing system support once implemented.

9.0 MANAGING AN EFFECTIVE TRANSITION FROM MANUAL TO AUTOMATED TRANSIT INFORMATION OPERATIONS

A well-designed automated transit information system can produce a variety of positive benefits, as described above in Section 5, to both the transit agency and to the general public. Transit officials charged with implementing an ATIS should not assume, however, that achievement of these benefits automatically follows the decision to establish such a system. It would be naive on their part to expect introduction of state-of-the-art computer technology to be received enthusiastically by all intended system users. For example, some agents might very well regard introduction of an ATIS as a nuisance, disrupting their normal work routine. Other agents might perceive system implementation as a threat to job seniority, if it enables newly trained agents to perform almost as efficiently as those having years of experience. Others might view it as an attempt by management to maintain current productivity levels with fewer overall agents. Still others may fear the ATIS because it necessitates the development of new job skills such as typing. In order to dispel such negative perceptions and ensure a smooth transition from manual to automated operations, a carefully controlled management apparatus must be in place and functioning throughout system analysis, and specification, and follow through during system design, development, and implementation. Management tasks during these three transition phases are described below.

9.1 PRELIMINARY SYSTEM ANALYSIS, SPECIFICATION AND DESIGN PHASE

Once the decision to move ahead with automation of telephone information operations has been made, actual experience at the three agencies evaluated shows

that intended user involvement in the transition process should begin as soon as possible. At WMATA, the Senior Supervisor of the Telephone Information Section was included as a member of the Contract Evaluation Board rating the merits of system proposals received. In the early stages of the design process, it is essential for software and hardware experts on the contractor team to have a clear idea of the agent's job and the types of data retrieval considered desirable. This information can only be obtained through agents or their supervisors articulating their needs to the computer specialists. It is interesting to observe that the designers of the CCIS in Los Angeles felt in retrospect that they should have enrolled in the training course for new agents before beginning system design. While extremely technical matters of hardware and software design will be beyond the comprehension of most information agents, their experience and expertise in data retrieval can provide valuable insights to designers as to what the end product should look like and how it should perform. Cooperation with system users in this phase helps to build confidence that the system ultimately implemented will be responsive to their needs.

9.2 SYSTEM DEVELOPMENT PHASE

During the system development phase, the task of establishing the various data bases supporting the ATIS will be undertaken. Although the system design contractor is responsible for the performance of this task, it is generally the responsibility of the transit agency to

make available raw data underlying these data bases for use by the contractor. Assembling these data into a machine-transcribable format that is useful to the contractor can be hindered by a number of technical and institutional factors.

The data elements underlying the transit system data base (routes, stops, schedules, fares, etc.) fall under the jurisdiction of a variety of departments within a transit agency, each with its own system for data generation, updating, and processing. In assembling these transit-related data, the managers charged with ATIS establishment must obtain up-to-date information from each department and somehow convert it to a standard format to use by the design contractor. Securing the cooperation of the various departments can be difficult to achieve, since the benefits to them of a unified transit system data base may not be readily apparent. Managers of these departments are unlikely to be willing to commit their budgets to reorganize data solely for the benefit of another department. At WMATA, the Office of Marketing eventually purchased word processing equipment for the Scheduling Department and trained Scheduling Department personnel in its use so standardized schedule data could be obtained for the ATIS data base. This action was justified to the WMATA General Manager on the basis of ongoing cost savings to the Scheduling Department in updating its own files for each schedule change. Thus, other departments within the transit property might well require tangible inducements before their cooperation in ATIS development is secured.

Generation of the geographic data base supporting the ATIS involves the assignment of X-Y coordinates to all

streets, landmarks, and street addresses within the ATIS service area. The magnitude of this task, which in the WMATA and SCRTD deployments was the responsibility of the design contractors, is dependent on both the extent of the service area and on the availability of up-to-date geographic data. In some locations, the U.S. Census Bureau has prepared digitized street address directories.

It should be emphatically pointed out that the system design contractors at both WMATA and SCRTD greatly underestimated and underpriced the amount of time and effort required to produce an error-free file of digitized geographic information for their respective ATIS service areas. Both firms had initially thought that the digitized U.S. Census files would be available. This proved not to be the case. Thus each contractor was faced with the very costly task of digitizing the entire service area on its own. Digitizing can be accomplished by hand-measuring detailed maps (the "ruler-and-eyeball" approach) or through the use of a machine called a flat-bed digitizer which automatically computes and interpolates X-Y coordinates when its pointer traces lines on a map. Hand-digitizing proved to be extremely labor-intensive and error-prone. Machine digitizing was constrained by access limitations, since neither contractor owned a digitizer. In retrospect, the negative experience of digitizing the geographic data at both properties led system designers and transit officials to realize that the efficient production of any future digitized systems would require uninterrupted access to state-of-the-art digitizing equipment. The manager of the WMATA system stated that if he were to repeat the entire process, he would purchase a digitizer for use

by the contractor, and either sell or lease it once the geographic data base was established. The MTC system, as stated above in Section 8, does not contain a geographic data base. Thus, the cost and effort of this particular phase of system development was avoided in Minneapolis-St. Paul.

To accommodate the computer equipment supporting an ATIS, a certain amount of construction and/or renovation is likely to be required within an authority's Telephone Information Department. The extent of this work depends on the computer hardware configuration selected by the authority. If the authority's mainframe computer is used to drive the system, installation of peripheral equipment such as terminals and printers is all that is required. If computers are to be dedicated to support the ATIS, heavier construction may be required. For example, at WMATA, an entirely new working environment for information agents was created. This involved installation of heavy heating, ventilating and air conditioning (HVAC) equipment for precise temperature and humidity control in the computer room (most larger computers require cool and dry surroundings) as well as ventilation of the agent work areas. Since the telephone information center operates long past normal working hours, it was considered desirable to control its ventilation independently of the HVAC equipment needed to service the rest of the WMATA headquarters building. As is sometimes the case in projects of this magnitude, unexpected delays were experienced in the delivery and installation of this equipment. Since the computer could not function without it, these delays also held up computer installation and ultimate system testing.

Thus, ATIS managers must be prepared to deal with problems of interdepartmental coordination, digitizing, data availability, and construction delays in the system development phase. Clear and open lines of communication with system designers and other departmental heads are essential to this process. Through the system development phase, input from system users becomes less crucial. It is very important, however, not to create the impression that system development tasks are proceeding without their participation. Inclusion of system supervisory personnel on a Working Committee will ensure that users are informed as to the development progress as well as provide a useful forum for agent input on development issues.

9.3 SYSTEM IMPLEMENTATION PHASE

As hardware and software testing of the installed ATIS proceeds towards completion, system managers should put into place mechanisms for effecting the various agent job changes as described above in Section 7 with a minimum of disruption. It is important for management to anticipate problems and minimize them before they occur, rather than react to them only after they occur. The history of the SCRTD's system implementation phase is a case in point.

At SCRTD, the system design contractor was initially given the responsibility of training information agents in ATIS operation. This training was accomplished with rather negative results. The worst apprehensions of the SCRTD agents concerning the new technology were confirmed by their early ATIS indoctrination. Many of the first agents trained complained afterward that the

initial training session was too short (it lasted only one eight-hour shift) and was too technically-oriented. As a result, the CCIS implementation period began with trained agents lacking in enthusiasm for system use. The negative results of these first training classes were quickly transmitted to the remainder of the agent work force. These negative feelings were exacerbated when agents detected errors in system response screens and there was no management mechanism in place for their correction. Agents soon lost confidence in the computer and reverted to manual processing, using the CCIS only for an occasional diversion in their routine. Thus, without effective management, the SCRTD's ATIS quickly fell into disuse.

SCRTD management, recognizing the failure of early system implementation, aggressively addressed many of its problems through the following actions:

- Establishment of a CCIS Working Committee - this committee established objectives for system usage, identified CCIS-related problems, recommended solutions to identified problems, and monitored system data to ascertain the achievement of objectives.

- Appointment of a Supervisor as full time CCIS Program Manager - this Program Manager was responsible for effective CCIS operation and served as the intermediary between the CCIS agents and the system technicians, effectively "speaking the language" and satisfying the information needs of both.

- Creation of a new program for CCIS agents involving retraining by the Program Manager and improved status and support - all agents desiring to work the CCIS were asked to volunteer for revised in-house training which was followed by a testing and certification process; these agents were assigned to desirable daytime work shifts and provided with a support program for resolving CCIS-related problems.

- Development of a program for greater interdepartmental cooperation in supporting and maintaining the CCIS transit data base - this program was aimed at developing more effective procedures for receiving and updating of data from the Scheduling, Planning and Stops and Zones Departments within the SCRTD in order to better assure the accuracy of the CCIS data base.

- Development of more effective control procedures over computer operations - since the CCIS was a pilot deployment, it was driven by the SCRTD's mainframe computer, whose operation falls under the jurisdiction of the Data Processing Department. When particularly large jobs (i.e., payroll computations) were run on this mainframe computer, CCIS response time dropped off sharply, creating delays that were still another source of agent frustration. Under the management initiatives, strategies were developed in conjunction with the Data Processing Department to schedule these major computations during late-night periods of low caller demand.

- Expansion of the CCIS log file system data collection program - working with the system design contractor, SCRTD management defined agent and system performance measures to be collected on a regular basis to better enable the Working Committee to analyze system operations and evaluate agent progress and skill development.

These actions represented a breakthrough in enlisting agent support and enthusiasm for the system. The implication of this SCRTD experience is that technical improvements to software and hardware are only part of the effort necessary to make an ATIS system work. To achieve the intended benefits of ATIS implementation a strong human commitment must also be made to the users. By providing agents with only perfunctory training and little management guidance as to what to do when the system did not function properly, the SCRTD lost user confidence and support.

At WMATA and MTC, lessons learned in the SCRTD experience were incorporated into the system implementation phase. Programs for agent training at both agencies were conducted by in-house system supervisory personnel who knew the apprehensions and motivations of the agents. Emphasis was placed in this training on the labor-saving, user-friendly aspects of the computer. Since the educational level of most agents is that of high school graduate, instruction programs were geared to that level. At both agencies, demonstration mockups of the agent computer terminals were placed in the information center so curious agents could familiarize themselves with the new equipment on their own before it was installed. The first agents to be trained were carefully selected by management for their overall maturity and experience, their receptiveness to changes in routine and for their capabilities, once trained, to set an enthusiastic example for the other agents. ATIS job changes, as discussed in Section 7, were not minimized. Instead, practice on new skills such as typing and scanning response screens were built heavily into the training program. Agents in the early training sessions were instructed to keep negative comments about the system to themselves, at least for the short run. It was generally conceded by system contractors that the data bases contained numerous errors; agents were openly told that these errors would occur, and that part of their job was to assist management in finding and correcting them.

It should be noted that at WMATA, this process was greatly facilitated by built-in error reporting functions in system software. If an agent received a response which he or she deemed questionable, it could easily be stored in a computer file for future reference. Sessions in which these questionable responses were discussed by agents and system designers proved to be particularly fruitful and instructive to both parties. In many instances, the minimum-travel time

routing selected by the computer was not the "intuitive" or "obvious" choice selected by the agent. Thus, WMATA and MTC management carefully controlled the shakedown, training and acceptance process to build maximum agent confidence in the system. The end result was a much more enthusiastic agent work force than was the case in Los Angeles before completion of the management initiatives there.

After agent training has been completed and the computer is actually being used to provide responses to callers, it is reasonable to expect that center productivity will fall off for several months while agents familiarize themselves with ATIS operation. Such productivity declines occurred in all three of the systems evaluated in the UMTA-TSC program. Once agents master the mechanics of data input and the range of transactions available, however, average productivity should increase to levels well beyond the previous manual call rates. Trouble reports on system errors will initially be numerous, but should taper off quickly once errors in the data base are corrected.

Once productivity bounces back and error reports decline, it is probably advisable for management to remove manual references from easy access by the agents. Physical removal of manual references prevents agents' using them as a "crutch" or as a double-check for computer screens, both of which hinder call productivity. While some hard-copy references should be maintained for use in the event of computer breakdown, these could be stored in supervisory positions away from the agents. Of the three ATIS demonstrations examined in this study, the MTC has so far physically removed manual references from agent work stations.

10.0 DATA RETRIEVAL FEATURES AVAILABLE THROUGH ATIS IMPLEMENTATION

This section provides a brief description of the range of data retrieval features available to telephone information agents at the three agencies visited during the course of this study. Because each transit agency is unique in terms of service area, number of routes, volume of caller demand, number of information agents, etc., there appears to be little likelihood of direct transferability of an ATIS from one agency to another, even one with similar operating characteristics. Rather, the potential for ATIS transferability lies in exchange of the theoretical framework underlying each of the various functions available to information agents.

It should be stressed that the ATIS concept in these three deployments is one in which a human operator is aided by computer data retrieval; i.e., there is still a human link between the caller and the computer. The ATIS operator's job is therefore somewhat like that of an interpreter, translating the caller request into machine-readable format for the computer and translating the computer's response screen, once obtained, back into useful information for the caller. A complete ATIS must therefore enable an operator to manipulate computer functions so as to provide all the information traditionally supplied to callers by a highly trained and experienced manual agent. ATIS operation for each of the four major caller request types (itinerary, schedule, route, and fare) is described below.

10.1 ITINERARY FUNCTIONS

A typical itinerary query ("How do I get from Point A to Point B?") would involve input by the ATIS operator of the street addresses of Points A and B and a time

input (either arrival or departure). The computer's itinerary routine would locate Points A and B on the digitized coordinate grid, scan nearby coordinates within a certain radius for transit routes and stops, and select feasible alternative itineraries from routes passing within this radius. It would then reference its transit schedule files for the selected routes and select runs that are scheduled to occur close to the agent time input, making allowances for walking distances, travel time and/or transfers if necessary. It would then calculate travel time and fare for the trip. For a given itinerary input, the computer will repeat this process numerous times, comparing the travel times of each complete feasible itinerary until some preprogrammed limit to computation is reached. Through such alternative comparisons, the optimal itinerary is determined and is flashed onto the response screen (route number(s), boarding time(s), fare, stop locations) usually with two or three of the next best alternatives. It might be noted that travel time is the trip variable most commonly optimized. Should the caller request it, the ATIS itinerary function can usually also optimize other variables such as walking distance, transfers required, fare, etc.

10.2 SCHEDULE FUNCTIONS

The typical schedule-related request ("When does bus X pass bus stop Y?") presumes a higher level of knowledge of the transit system on the part of the caller than does the typical itinerary request. Input variables would be the bus route designation, stop location, and time of departure or arrival. Given these inputs, the schedule routine would select the headway sheet for the route in question and reference the given bus stop

location. Bus arrival times for the given route designation at that stop would be displayed on the response screen for a preprogrammed "time window" before and after the time input by the agent.

10.3 ROUTE FUNCTIONS

The typical route-related question ("What bus goes near location Z?") again presumes a higher level of transit system knowledge on the part of the caller than does an itinerary request. Agent input data consists of the location in question. The computer route function then scans its digitized grid for a preprogrammed radius around this location and determines all bus routes within the radius. These routes are then displayed on the agent's response screen.

10.4 FARE FUNCTIONS

The typical fare-related question ("How much will it cost?") usually occurs as a followup to an itinerary question. For that reason, fare computation is usually subsumed as part of the itinerary function, particularly if the transit property's fare structure is based upon geographic fare zones.

10.5 SPECIALIZED FUNCTIONS

In addition to the four major caller response functions described above, a range of subsidiary specialized functions are available to information agents at SCRTD, WMATA and MTC to assist them in data retrieval. While each of these functions, described below, is not available at every deployment, they enable agents to accomplish the following tasks:

- Walking Instructions - Experienced agents often take pride in being able to describe those parts of an itinerary that a caller must make on foot; that is, the journey from point of origin to the "boarding" bus stop and from the "alighting" bus stop to the destination point. Such instructions must contain at least information on both distance and direction of travel. They might also include descriptions of landmarks along the route or nearby. These data are provided by manual agents from map references. ATIS operators using a walking instruction function, without reference to maps, can provide direction and distance information directly from their response screens.

- Load Factors - To some elderly or handicapped callers, finding an available seat on the bus or train is a crucial factor in modal choice. By incorporating load factors into itinerary responses, it is possible for information agents using this function to provide some indication to callers as to the likelihood of finding a seat on a given bus at the time of day in question, or to indicate if wheelchair lift-equipped buses operate on a particular route.

- Last Bus - One frequent schedule-related question is "What time does the last bus pass a given stop?" By manipulating the ordinary schedule function so that its "time window" includes the last bus, an agent is generally able to determine the answer to this question. Activating a "last bus" function provides this response to the agent without requiring any guesswork as to the appropriate "time window".

- Forcing Function - Callers often persist in requesting information concerning routes familiar to them even if these routes are not considered "optimal" by the computer for their stated trip purposes. In order to accommodate these callers without receiving information only on "optimal" routes, ATIS operators accessing a "forcing" function, can limit computer processing only to routes specified.

- Landmarks - Rather than require the entry of street addresses for local landmarks as origin or destination points, ATIS geographic data bases often contain directories of such landmarks for agent input. For example, at WMATA, under the landmark function, "White House" could be used interchangeably as an input with "1600 Pennsylvania Avenue, N.W."

- Abbreviations - To minimize agent input time, landmark and other geographic data are often abbreviated in data files using the example above, "White House" might be entered by the agent as "Wht Hse."

- Return Itinerary - Once a given itinerary is supplied, itinerary callers frequently (about 30% of the time) request data for return itineraries at another time of day. Rather than re-process a whole new itinerary transaction, an agent using a "return" function need only specify another time of day. The computer automatically reverses origin and destination points and generates a new optimal itinerary for the return trip.

- Map Coordinates - If, as at the SCRTD, all information operators use a standard street map book as a reference, a function which provides map coordinates for origin and destination points can be useful in verifying locations or providing walking instructions.

- Scrolling - For situations similar to the "return itinerary" process described above, it is sometimes useful for agents to obtain schedule information for a different time during the day for the same bus. One method of obtaining this information is to "scroll" the schedule response a certain number of lines up or down the headway file for a given route until the different time in question comes into view. Such a function eliminates the need for processing a new schedule transaction to obtain information for a different time of day.

- Trouble Reports - Despite the best efforts of system designers and maintenance personnel, agents occasionally encounter a computer response screen that to them appears to be in error. A "trouble report" function can automatically store such a response screen, together with the agent inputs which promoted it, in a special file for later evaluation by supervisory personnel.

- Bulletins - By accessing a "bulletin" file, agents can obtain up-to-the-minute information concerning special circumstances that cause revisions to normal service, including construction detours, parades, discontinued runs, etc.

10.6 CHARACTERISTICS OF THE THREE SYSTEMS EVALUATED

It should be emphasized that not all of the features described above are available to agents in each of the three ATIS deployments surveyed in the UMTA/TSC evaluation program. Rather, each system contains some, but not all, of these features. Table 10-1 displays the characteristics of each. From this table, it is evident that the CCIS at SCRTD and the AIDS at WMATA are fairly comprehensive in the range of functions provided. In addition to the four major response types (itinerary, schedule, route, fare) the WMATA AIDS system provides walking instructions, bulletins, landmark files, and trouble reports. The SCRTD CCIS system also provides the four major functions; other features include map coordinates, load factors, forcing functions and return itineraries.

The TIC system at MTC, however, is quite limited in the range of functions available when compared to the others. Of the four basic response functions, it is designed to provide only schedule-related information transcribed directly from the RUCUS schedule data base. Thus, as

TABLE 10-1. SOFTWARE CHARACTERISTICS OF ATIS DEPLOYMENTS INCLUDED IN THE UMTA/TSC EVALUATION PROGRAM

SYSTEM FEATURES	ATIS DEPLOYMENT		
	SCRTD CCIS	WMATA AIDS	MTC TIC
ITINERARY	X	X	
SCHEDULE	X	X	X
ROUTE	X	X	
FARE	X	X	
WALKING INSTRUCTIONS		X	
LOAD FACTORS	X		
LAST BUS	X		
FORCING FUNCTION	X		
LANDMARKS	X	X	X
ABBREVIATIONS	X	X	
RETURN ITINERARY	X	X	
MAP COORDINATES	X		
SCROLLING			X
TROUBLE REPORTS		X	X
BULLETINS	X	X	X

discussed above, it specifically lacks a geographic data base and the itinerary-constructing capabilities that are dependent on digitized geographic information. Agents using the TIC system must therefore undergo thorough training in route selection and itinerary construction, and rely on the computer only for specific schedule information once they make judgements as to optimal itineraries. The TIC system does include a listing of routes passing near landmarks and a file of park-and-ride bus stops and bus stop shelters, but these data are not tied in to any geo-coded data.

10.7 OTHER TYPES OF ATIS

As stated above, these three deployments were based on a human link between caller and computer. In several locations around the country, other ATIS deployments are currently under development in which an attempt is made to eliminate the transit information agent completely and to provide a direct interface between caller and computer. These computerized rider information systems (CRIS) feature a computerized "voice" which responds to caller requests. Because of the limited capacity on the part of the caller to send or receive detailed information (the average household lacks a computer CRT link on its telephone), these CRIS systems are able to transmit only rudimentary information to the caller in comparison to the more sophisticated ATIS systems described above. They also presume a relatively higher degree of transit system knowledge on the part of the caller than the ATIS systems require. A typical CRIS system transaction would involve a caller dialing a predetermined telephone number for information concerning a given bus stop, such as in the Teleride system or the system in Erie, PA.

The CRIS computer would respond with the scheduled arrival times for the next two or three buses at the stop in question. Thus, the CRIS system specifically lacks the capacity to provide itinerary, route or fare information, and operates on the presumption that callers know the correct telephone number for their particular route and stop. With the continued proliferation of home computers, it is conceivable that callers might someday possess the capability for receiving more detailed transit information automatically. For the present, however, operator-activated ATIS systems provide a far higher level of service and information to the public.

11.0 COSTS OF ATIS DEVELOPMENT

11.1 FACTORS INFLUENCING SYSTEM COST

Costs of automated transit information system analysis, design, development and implementation are influenced by a number of factors specific to a given transit agency. Among these factors are:

- Volume of caller inquiries and telephone information agent productivity levels considered desirable from a marketing standpoint. These factors are essentially the demand and supply of telephone information. The extent of the deficit between supply and demand to be overcome by ATIS deployment has important implications on staffing (the number of information agents who will be trained to use the ATIS) and on system response time (the average time saved on each call due to automated retrieval).

- Types of system transactions considered desirable. If automation of the entire range of agent data retrieval functions is intended, then the ATIS must contain both geographic and transit system data bases, as well as route-finding software, in order to provide itinerary responses. Development of additional system transactions or features will obviously add to overall system costs, but may add flexibility and productivity benefits as well. These features are described in Section 10.

- Geographic size of the service area to be covered by the ATIS. Should itinerary responses be considered desirable, ATIS development costs will include the digitizing of all streets, landmarks, and addresses in this area. As the size of this area increases, the costs of creating and maintaining an error-free geographic data base increase significantly. It should be emphasized that maintenance of geo-coded data is a continuing expense, as bus routes and local land development are constantly changing.

- Extent and complexity of the transit network covered by the ATIS. Storage requirements for the transit system data base, which includes information on routes, stops, schedules, and fares, obviously increase as the transit network to be covered expands.

- Computer hardware configuration considered desirable. The hardware configuration is a function of system data base storage requirements and input-output variables such as the number of agents using ATIS simultaneously and system response time specifications. It is also determined by the degree of control over computer operations considered necessary for effective system use (i.e. dedicated or time-shared).

- Training and transition support for agents selected to use the ATIS. Costs must include investment in the human aspects of the system as well as in system hardware and software.

- Quality of raw input data for system data bases. If these data are already integrated into a format that is useful for system development, the expense of collecting and/or transcribing inputs can be avoided.

11.2 COSTS OF THE THREE SYSTEMS EVALUATED

Table 11-1 presents a comparison of various of the factors described above for the three systems included in the UMTA/TSC ATIS evaluation program. This table shows that the WMATA AIDS system is by far the largest and most complex of the three. Its data bases cover the entire WMATA service area of over 1500 square miles and its dual HP 3000 minicomputer hardware processes over 200,000 calls per month on an average of 27 agent terminals. The MTC's TIC and the SCRTD's CCIS systems are small by comparison. The TIC, driven by a TI90-series minicomputer supporting 11 terminals, specifically lacks itinerary-constructing capabilities and therefore does not contain a geographic data base. The CCIS is a prototype deployment whose coverage is limited to the 300-square-mile San Fernando Valley portion of the SCRTD's service area. Its seven terminals are driven on a time-shared basis with other SCRTD departments by the District's Univac 1106 mainframe computer.

Table 11-2 presents approximate development costs of the three ATIS deployments evaluated. It is not surprising, in light of the data presented in Table 11-1, that the deployment

TABLE 11-1 OPERATING CHARACTERISTICS OF THE THREE ATIS DEPLOYMENTS INCLUDED IN THE UMTA/TSC EVALUATION PROGRAM

SYSTEM	AVERAGE MONTHLY DEMAND (THOUSANDS OF CALLS)	ONE-WAY BUS ROUTES (PK.HR.)	SERVICE AREA (SQ.MI.)	CENTRAL PROCESSING UNIT	AVERAGE NO. OF TERMINALS
SCRTD-CCIS	35	64[A]	300[A]	UNIVAC[B]	7
WMATA-AIDS	200	733 PLUS RAIL SYSTEM	1500	DUAL [C] HP 3000	27
MTC-TIC	105	252	550	TI 99[C]	11

NOTES:

A San Fernando Valley Portion of SCRTD Service Area Only

B On Time-Shared Basis With Other SCRTD Departments

C Dedicated Exclusively to ATIS

TABLE 11-2 DEVELOPMENT COSTS OF THE THREE ATIS DEPLOYMENTS INCLUDED IN THE UMTA/TSC EVALUATION PROGRAM (IN THOUSANDS OF DOLLARS)

SYSTEM	DEVELOPMENT COST ELEMENT				TOTAL SYSTEM DEVELOPMENT COST
	FEASIBILITY STUDY	COMPUTER AND HARDWARE	DATA BASES	OTHER SOFTWARE AND SUPPORT	
SCRTD-CCIS	35	40[A]	110	100	285
WMATA-AIDS	150	300	250	250	950
MTC-TIC	5	200	10[B]	10	225

NOTES:

A No CPU purchase necessary as SCRTD's Univac Mainframe drives the System.

B Costs shown are for conversion of RUCUS Data Base already developed.

cost of the WMATA AIDS was over three times that of the SCRTD or MTC systems. Table 11-2 shows that the SCRTD managed to save a considerable amount in hardware costs in comparison to WMATA and MTC by using a time-shared mainframe computer owned by the District rather than purchasing a dedicated central processing unit. According to the CCIS Program Manager, expansion of the SCRTD prototype system to cover the entire service area outside the San Fernando Valley would require investment in a dedicated mainframe driving approximately 40 terminals. He estimated that such a deployment would cost over $3 million to implement.

In developing its system data base, the MTC was able to use an up-to-date and comprehensive RUCUS data base developed by its Scheduling Department through a relatively low-cost conversion process. The MTC also made the choice not to develop a geographic data base; as a result, the cost of the TIC's data base is only a fraction of the costs incurred by the SCRTD and WMATA in this task.

12.0 ACHIEVEMENT OF INTENDED ATIS DEPLOYMENT BENEFITS

As described above in Section 5, deployment of an ATIS by a transit property can produce a number of benefits to both the property and the general public. These benefits include:

- improved productivity in terms of agent calls per hour answered due to more rapid data retrieval;
- increased reliability and consistency of agent responses;
- a reduction in training time for new agents;
- improved capability to rapidly update agent data references;
- enhancement of overall agent job satisfaction;
- expanded capabilities to monitor agent and system performance; and
- use of the reference data base by others as a planning resource.

This Section will discuss the achievement in each of these benefit areas by the three ATIS deployments evaluated in the UMTA/TSC program. Due to the unique nature of the deployments, relative success in each area varied widely from location to location. In areas where evaluation data tend to point out certain results, an attempt will be made to infer more general conclusions.

12.1 AGENT PRODUCTIVITY

As mentioned above in Section 9, it is reasonable to expect a substantial drop in information agent productivity in the months immediately following ATIS installation. Such a reduction was observed in all three deployments evaluated, and ranged from 15-50% of average manual productivity before implementation. Over a period of six to eight months, however, agent productivity at the three deployments increased

to the point where it usually surpassed previous manual averages by 10-15%. A variety of rather conflicting productivity data were collected in the evaluation program.

At the SCRTD, "projected" call counts calculated by the CCIS averaged almost 30 per hour, a 50% increase over the SCRTD manual standard of 20. It should be emphasized that these "projected" hourly counts were derived by dividing average CCIS call times in seconds into 3600; no allowance was given for any break time between calls. Call data showed CCIS agents did not perform at this 30-per-hour rate during the evaluation. Their self-admitted counts reported on agent questionnaires were much closer to 20. The CCIS Program Manager was able to explain this discrepancy by pointing out that the working styles of CCIS agents can be classified into two separate categories. Agents in the first category tend to work at a relatively steady pace of slightly over 20 calls per hour, with brief breaks in between calls, while agents in the second category tend to work in spurts, handling a large number of calls in a brief period (at the 30 call per hour rate) and then taking extended breaks to "cool down". The end result of both styles is a call rate approximating 20 per hour. During the CCIS evaluation period, SCRTD management did not possess the capacity to monitor agent break time between calls. The steady working pace, described above, is preferred by management since it exerts much less stress on the agent. A prime advantage of CCIS over manual retrieval, the Program Manager noted, is that all CCIS calls, even those involving the most complex itineraries, are of relatively uniform length. CCIS agents are thus enabled, much more so than their manual counterparts, to develop this steady working pace.

In the summer of 1982, the SCRTD installed new telephone equipment which enabled supervisors to monitor agent break time. With the introduction of this equipment, agent call

counts rose to 25-30 per hour and held steady. Thus the productivity increase at SCRTD cannot be attributed entirely to the CCIS, although it was certainly a contributing factor.

At WMATA, performance testing by management again demonstrated that agents using the AIDS data retrieval system could handle calls at a pace of 30 per hour and upwards. Agents, however, were rather evenly divided on the after-implementation questionnaire regarding AIDS influence on call counts, and a number of them complained about system response speed. Data collected during the WMATA evaluation, which took place approximately 5 months after system implementation, showed that overall call productivity was still approximately 10% below pre-implementation levels. Nevertheless, agents were almost unanimous in the opinion that AIDS made their jobs easier. WMATA supervisory and management personnel were able to shed some light on causes underlying these conflicting results. It appears that at current system response speeds, schedule questions are still handled fastest manually; this fact is supported by call monitoring data which show that the majority (85%) of schedule calls still prompt agents to use manual retrieval methods. Thus, agents who use the computer for nearly every call are actually less productive than those who use it more selectively. Varying agent experience levels are also a factor; experienced agents tend to rely more on memory in making responses than do newer agents. Answering from memory is much faster since no data retrieval is involved. Supervisory personnel indicated that very experienced operators (having 10 or more years on the job) are able to answer up to 75% of their calls from memory. These operators tend to use AIDS only for calls requiring construction of long or complex itineraries. It is not surprising, then, that more experienced operators would feel that using the computer would slow them down in most instances. but would still be of the opinion that AIDS made their jobs easier (for the more complex queries).

After initial productivity drops following implementation WMATA management made it clear to agents that AIDS was not necessarily the most efficient or productive way to respond to every call. Using a mixture of manual and computer retrieval, agents were able to achieve call counts equal to or better than their previous manual averages. Supervisory personnel indicated that a 50-50 balance between manual and computer retrieval generally produced the highest call count. Thus, while computer use at WMATA does increase productivity to a certain extent, it is clear that this system is still extremely dependent on manual retrieval methods to achieve high productivity levels. Perhaps future improvements to decrease the response time and increase the information provided by the AIDS schedule function will change this situation.

At the MTC, agent productivity dropped off sharply in the post-implementation period. These productivity drops were partly due to the fact that budget cutbacks forced the layoffs of several agents. They were also attributable in part to the concurrent installation of a new telephone system which necessitated changes in agent routine. This telephone equipment, in the opinion of system supervisory personnel, was a decisive factor in improving productivity, since it provided an unbiased record of agent calls and break time between calls. Faced with completely accurate records of their daily performance, agents were given added incentive to perform up to MTC productivity standards. Another contributing factor to productivity increases at MTC was the division of the agent work force into competitive "teams". The team with the highest overall productivity for a given period is awarded cash bonuses or merchandise certificates. According to supervisory personnel, agents responded enthusiastically to these incentives. The new telephone system enabled management to post daily "scores" for each team. Still another underlying cause for improved productivity at MTC was the decision by management to remove manual references from easy

access by agents. Thus, agents were prevented from double-checking computer responses against manual data, a process which reduces productivity considerably. A technical memo on TIC productivity produced by MTC management indicates an 11.7% increase in call productivity for the year following implementation. Using average agent wage figures, this increase was calculated to correspond to a dollar savings of $27,500 per year.

The implication of agent productivity analyses at the three ATIS deployments is that while ATIS implementation is conducive to higher agent productivity, it does not necessarily assure this result. A number of other factors, such as management control over agent break time between calls, removal of manual references, and the provision of incentives have all been employed successfully as supplementary measures to increase agent productivity.

12.2 RESPONSE ACCURACY AND CONSISTENCY

Deployment of these three systems required the creation of data bases that were large and complex. Problems encountered in the development process in Los Angeles and Washington left numerous errors in these data bases, particularly in the digitized geographic reference files. At the MTC, this problem was largely avoided due to management decisions not to create a geographic data base and to use the RUCUS schedule file, which had already been extensively debugged. Over an extended period, the SCRTD and WMATA systems worked out initial data errors through refinements and corrections in consultation with information section supervisors and through built-in "trouble report" routines in which agents could store responses which they considered suspect. Review of

these "trouble reports" not only corrected the errors, but proved to be instructional to agents as well, since the suspect computer response was occasionally the "best" response under the circumstances.

Agents at the three agencies were quite unanimous in their opinions that ATIS-assisted responses were more accurate and incorporated a greater level of detail than was previously possible under manual operations. In the opinion of the Senior Supervisor at WMATA, this increase in accuracy was the single most important benefit of system implementation. Accuracy of automated responses makes it possible for novice agents to provide the same high quality information as their more experienced counterparts. While it is difficult to assign a dollar value to accuracy improvement benefits, they are clearly essential to system integrity.

It cannot be overemphasized that the achievement of nearly 100% response accuracy at the three deployments was the result of an interactive process in which agents and supervisors were energetic participants. Agents are very impressed by the management position that "Errors do exist in the system. Part of your job is to help us find and correct them." This interaction results not only in error corrections, but also in increased confidence on the part of the agents that the system is being structured to their individual needs.

12.3 AGENT TRAINING REDUCTION

Experience regarding training time reductions for new agents varied considerably among these three ATIS deployments.

At the SCRTD, interviews with Information Section management indicated that perhaps the greatest positive impacts exerted by the CCIS on the Telephone Information Section's operations would be in the area of agent training. By drastically reducing the need for agent memorization,

the standard agent training period may be cut at least in half through ATIS implementation. If trainees already possess typing skills, this training period may be even shorter; the CCIS Program Manager cited the experience of training two Kelly Girl temporary employees to reasonable proficiency on the system in only one week. According to SCRTD management officials, this reduced training time has strong potential for benefits in the areas of improved personnel recruitment and retention. The work force from which agents are recruited can be greatly expanded to include older and part-time employees, neither of which was previously suited for the rigorous traditional agent training course. The long-term implication of these training benefits is significant savings, although the limited experience with training of new agents thus far makes these savings difficult to quantify.

In contrast to the Los Angeles experience, interviews with Information Section Management indicated that anticipated savings of training time for operators might not be achievable, based on results with four new agents. These agents received a two-week course which included computer instruction, communications skills development, and some rudimentary background in use of manual references (they already possessed typing skills). They were not given the intensive geographic and transit system practice which forms a major part of traditional manual training. After two weeks, these agents were producing "acceptable" call counts of 80-90 per day, and it seemed as though the training reduction benefit was achieved.

Reports from supervisory personnel, however, soon produced evidence to the contrary. Without the geographic and transit system practice, these new agents were unable to provide details to callers concerning landmarks, etc. which supervisory personnel considered necessary for caller comprehension. Even worse, they were unable to make interpretive judgements between the four feasible alternative responses

routinely produced by AIDS. In the opinion of the supervisors, they became too dependent on the computer for "simple" questions, such as fare and schedule requests, which other agents would have handled manually or from memory. To remedy these observed deficiencies in their performance, these agents were later given additional training emphasizing map work and manual schedule practice. With this additional training, these agents were better able to picture routes, intersections, and landmarks, and achieved full proficiency (150-170 calls per day). The net result of this experience was to point out to WMATA management that agents with AIDS training, but lacking a good grounding in manual practice and geographic data manipulation, are of marginal value. While these operators could be used as a stopgap measure during periods of critical manpower shortage, their long-term usefulness is limited at best.

At the MTC, the TIC system does not include a geographic data base or itinerary-producing capabilities. New agents at MTC are therefore still required to undergo the full intensive geographic and transit system training that agents experienced pre-implementation. In fact, the addition of computer retrieval to the agent's job actually lengthened the training period from 7 to 9 weeks. Thus, at the agencies evaluated, post-deployment training times were significantly shorter at SCRTD, were comparable, although perhaps slightly shorter at WMATA, and were longer than before at MTC. From these conflicting results, it is difficult to discern any conclusive trend.

12.4 UPDATING OF DATA BASE

Centralized updating of the agent reference data base has been recognized by management as a substantial benefit at all three of the agencies evaluated.

At the SCRTD, the potential for considerable savings has been raised, as system operations have demonstrated that one full-time employee could perform the updating tasks currently performed by 15 supervisory personnel. With centralized updating, updating through annotation and modification of hard copy is no longer required except in the case of a small number of reserve manual references to be kept in case of computer breakdowns.

A side benefit of centralized data base updating would be an improvement in the job of supervisor. At present, supervisors spend practically all their time performing update functions. As a result, their skills as agents tend to gradually diminish to the point where they are below those of less experienced agents. Centralized updating would free the supervisors to perform the functions for which their jobs were originally created: troubleshooting and solving agent problems as they occur.

Because the CCIS is presently a small pilot deployment, these benefits have yet to be realized at the SCRTD except as regards data pertaining to the San Fernando Valley. With systemwide application of the CCIS, however, it is quite likely that the 95 complete sets of manual references currently maintained will be drastically reduced.

At WMATA, due to circumstances discussed above, manual reference use is still encouraged by information section management. As a result, hard-copy reference modification is still proceeding as before implementation. The various AIDS data bases are maintained by one full-time employee. Updates are made so frequently on the computer that the AIDS geographic data base is becoming recognized as the most accurate address directory available for the D.C. metropolitan area.

At the MTC, centralized data base updating proved to be so successful that the decision was made approximately six months after system implementation to eliminate hard-copy schedule references from agent work stations. Management at MTC took this action because they felt that the manual references were less accurate then the computer data and that double-checking of computer responses against manual references was counterproductive. Elimination of the manual references has been estimated by MTC management to produce a savings of $65,000 per year. Based on this benefit alone, the TIC system will pay for itself in less than four years! In case of computer malfunction, agents are provided with a computer-generated printout of schedule data. Because of extremely high computer reliability, however, these data are used only on very rare occasions.

It should be noted that updating will necessarily be an integral part of any ATIS deployment, as neither the transit system nor local geographic characteristics remain static. Updating functions generally require the services of one full-time employee at large transit properties such as SCRTD and WMATA. At the MTC, the system data base relies directly on input from the RUCUS system operated by the Scheduling department. Thus any system update functions are performed by Scheduling rather than Telephone Information personnel.

12.5 AGENT JOB SATISFACTION ENHANCEMENT

Job satisfaction is an elusive concept, one which is difficult to quantify. It is usually stated in relative terms ("Are you more or less satisfied than before?", for example). Through interviews and questionnaires, an attempt was made to measure impacts of ATIS deployments on information agent satisfaction at SCRTD, WMATA, and MTC.

The SCRTD experience with system implementation points out very graphically that agent job satisfaction is a crucial factor to overall system performance. Agents at SCRTD were initially unsatisfied with CCIS responses and management mechanisms for resolving problems, and they elected not to use it. Once management took the initiative to address these problems, agent enthusiasm for the system increased substantially. CCIS agent responses to opinion surveys demonstrated that a sizable percentage of agents felt that CCIS influenced their jobs positively, and that this percentage showed an increasing trend over the course of the evaluation period.

At WMATA and MTC, by contrast, data collected throughout the evaluation point to the fact that ATIS deployment has been well-received by agents. Factors mentioned by agents as contributing to job satisfaction enhancement included new skill development, the ability to use state-of-the-art technology, and more professional treatment from management. On the after-implementation questionnaire, WMATA agents were asked to rate AIDS influence on job satisfaction. To this question, 76% replied "positive influence" and the remainder replied "no influence". None of the responding agents replied "negative influence". MTC supervisory personnel were strongly of the opinion that information agent morale had been given a boost by system implementation, simply through the elimination of the more tedious aspects of the agent's job.

12.6 AGENT PERFORMANCE STATISTICS

Experience at all three of the ATIS deployments has conclusively demonstrated the potential of the computer as a performance data collection tool. All aspects of system performance are accurately recorded.

At the SCRTD, far more data is now available to Information Section management concerning agent and system performance than was previously the case. Automated data collection in some instances frees supervisory personnel from paperwork and data recording. Since the CCIS is a pilot deployment, however, data is collected only from one portion of the total SCRTD service area; management must rely on previous methods for the remainder.

At WMATA, computer-gathered data are currently being routinely used by management to monitor system performance. Since implementation, the quantity and quality of these performance data have increased tremendously. Unfortunately, however, some items are still lacking, because AIDS stores information concerning computer transactions only, and manual calls, which still account for over half of the total, remain undocumented.

At the MTC, the majority of system performance data is currently being collected not by the ATIS computer, but by a microprocessor built into the information section's telephone system. This system provides statistics on all aspects of telephone use by agents. It is by far the most comprehensive of the three deployments evaluated in terms of performance data collection. The availability to management of unimpeachable agent performance data at MTC is a strong incentive for agents to perform up to productivity guidelines.

12.7 INTERDEPARTMENTAL/SPINOFF USES

Although ATIS implementation is intended primarily for the benefit of providers and users of telephone transit information, an ATIS can also produce benefits for other departments within the transit agency and for the general public. Examples of potential benefits within the property are as follows:

- Bus stop/Kiosk information - since the transit data base supporting the ATIS contains detailed schedule information for major stops on all routes in the transit system, it can be used to generate schedules for posting at bus stops and kiosks.

- Operating cost/assessment information - an ATIS containing a geographic data base can be used to calculate travel distances through manipulation of the geographic data coordinates for each route. Applying these distance data to appropriate schedule information yields route-miles of service. Making these calculations in this fashion could greatly simplify the process of assessing local jurisdictions for their fair shares of transit costs.

- Financial Planning - The operating cost calculation described above could also be used to estimate potential added expenditures or savings due to proposed changes in service by applying a fixed operating cost per route-mile.

- Schedule Checking - when new schedule data are entered onto the ATIS data base, they are automatically screened for logic and consistency. This process spots errors and typing mistakes before the schedules are printed.

- Market Research - the ATIS can be used as a resource by a property's planning department. For example, origins and destinations of all itinerary calls can be superimposed against a system route map to determine whether service is adequate in areas with high information demand. Frequency of demand for information on certain bus routes can be compared with frequency of service on these routes.

Potential benefits generated by an ATIS to users outside the transit property are as follows:

- Ridesharing - an ATIS incorporating a geographic data base could be used for matching potential users of carpools/vanpools based on their desired trip origins and destinations.

- Geographic Reference - the geographic data base supporting an ATIS, if well-maintained, can be used by other government agencies as a planning resource, since it contains such an accurate street address directory.

- Remote terminals - the transit agency could use the ATIS to enhance its public image by placing remote terminals driven by the ATIS computer at transportation terminals or other locations in which there is a high demand for transit information.

While the interdepartmental/spinoff applications potential of an ATIS is thus extremely high, this potential has as yet not been exploited to a great degree by these three agencies. At the SCRTD, although a CCIS Working Committee has been established for the purpose of interdepartmental coordination of CCIS activities, the full benefits of a totally integrated data base incorporating stops, zones, routes, and schedules have yet to be fully realized. This situation is the result of several factors:

- The CCIS is currently limited to the San Fernando Valley in its pilot demonstration;

- The Stops and Zones and Scheduling Departments currently use their own data processing systems which are incompatible with the Univac 1106 supporting the CCIS; and

- Management of other SCRTD departments appears to have little detailed knowledge of the characteristics or potentials of the CCIS.

At WMATA, certain interdepartmental applications have been implemented:

- The WMATA Scheduling Department has benefited from standardization and storage of its data or word processing equipment. While this standardization and storage effort was a necessary expenditure for the establishment of the AIDS transit data base, the Scheduling Department continues to enjoy costs savings as a result each time schedules are updated. Since this is an ongoing process these savings will continue indefinitely.

- The AIDS transit data base was used as a resource by the WMATA Planning Department in the recent implementation of the RUCUS driver scheduling system. It is estimated that having this transit data fully organized saved WMATA over $50,000 in implementation costs for RUCUS.

At the MTC, the situation at WMATA was reversed. In this case, the RUCUS data bases, already established by the Planning and Scheduling Department, were used in establishing the TIC data base. Thus, possession of a workable RUCUS system saved the MTC considerable ATIS development costs. At the MTC, the ATIS is viewed by management as a stand-alone system; little or no effort has been expended in developing other system applications. This is partially due to the fact that the TIC does not incorporate a geographic data base. It is also due to the fact that the Planning and Scheduling Department, which generates the RUCUS files for each succeeding schedule, already possesses all the information contained in the TIC's data base.

13.0 CONCLUSIONS

The wealth of socio-economic data collected at the SCRTD, WMATA and MTC over the course of the evaluation allow a number of general conclusions to be drawn concerning ATIS technology and its functionality in a transit telephone marketing environment.

The first and most important of these conclusions is that ATIS technology does work. Controlled experimental results as well as ongoing performance data collected during the program indicate that automated data retrieval is indeed a viable alternative to traditional manual methods. While the three systems encountered numerous developmental problems, and the transition from manual to automated operation took longer than expected, the eventual enthusiasm on the part of information agents for computer retrieval proves that these problems were not insurmountable. In fact, they were symptomatic of those obstacles encountered whenever new technology is substituted for skilled labor.

A second conclusion is that any ATIS deployment, if it is to be effective, must have the full confidence and support of its users, the transit information agents. Building and nurturing this support throughout system design and implementation is one of the key ingredients to a smooth, successful transition from manual to automated operations. This transition process is one in which numerous opportunities exist for the dismal failure of well-intentioned management approaches. User confidence and support is developed through open dialogue, recognition of their tremendous system knowledge, and admission on the part of system designers and management that agent input is crucial.

Another related conclusion is that system designers, besides possessing detailed knowledge of computer software and hardware, must also have a clear idea of the information

agent's various job functions. In essence, they must bridge the gap between the technical and the practical, and learn to "speak the agents' language". The agents, in order to provide meaningful input to the designers, must also make an effort to do the reverse, and articulate how they feel the system should perform. This task was equally difficult for the technicians as for the information agents. The Los Angeles demonstration almost failed as a result of there being no formally established management apparatus to promote and maintain this critically important exchange. In Washington, management recognized this need early and assumed responsibility for agent training and agent trouble report diagnosis, giving the agents a clear notion of procedures to follow when they perceived that something was wrong. Later establishment of such a management apparatus in Los Angeles had a dramatically positive impact on agent performance and enthusiasm for the system, judging from agent opinion survey responses before and after. At the MTC, system designers observed agents for two weeks before beginning conceptual design. It is instructive to note that in retrospect, the Los Angeles designers felt that it would have been useful to enroll in the standard training course for new agents.

Another conclusion of the evaluation is that agent productivity increases should not be the only justification for ATIS implementation. By reducing data retrieval time to a fraction of that required for manual reference, ATIS implementation is theoretically a source of considerable productivity improvement. In practice, however, it appears that many agents can answer a significant percentage of calls (up to 25%) from memory and that agents occasionally take extended breaks between calls. The implication of both of these facts is that ATIS implementation, although conducive to improved productivity, does not necessarily cause it.

Other management productivity controls and incentives, such as the telephone systems which keep track of agent break time at the SCRTD and the MTC, and the agent team competition at the MTC, were also important contributing factors to improved productivity at these deployments.

The data collected during the course of the evaluation concerning training time reductions for new agents is so conflicting as to be inconclusive. From these results, it appears as though achievement of this benefit depends to a large extent on the exact types and formats of itinerary and various other functions designed into the individual systems. At the SCRTD, the reduction was evidently quite significant and was viewed as the most important benefit of system implementation. At WMATA, reductions were much more moderate. At the MTC, the new agent training period actually increased as a result of system implementation.

From the diverse features and operating characteristics of the three systems evaluated, it is evident that ATIS development and implementation is a process unique to each transit agency. While the concepts underlying various system features are transferable from one system to another, all of the local geographic and schedule data elements must be gathered into data bases at each agency. It is clear from the experience of SCRTD and WMATA that creation of a comprehensive ATIS (one which provides at least itinerary, schedule, route and fare responses) for a large agency can be a very expensive proposition; both agencies experienced cost overruns in the production of geographic and transit data bases. In addition, the capacity of the computer required for storage and manipulation of these data bases also dictates a large expense. Aside from software and hardware procurement costs, there is also a significant expense involved in system maintenance and enhancement. Due to all these cost factors, it appears as though a comprehensive

ATIS is appropriate only to large and complex transit agencies. The MTC's ATIS might be regarded as a contradiction to this conclusion, but it must be remembered that the TIC lacks a geographic data base and/or any itinerary response capabilities. In comparison with the SCRTD and WMATA systems, it should actually be classified only as a "partial" ATIS.

Based on the success of the TIC in achieving various of the intended ATIS deployment benefits mentioned in Section 12, it is evident that even "partial" ATIS deployments can be very useful, especially for medium-sized and perhaps even smaller properties. It should be remembered, however, that the TIC's creation was preceded by the establishment of a complete RUCUS data base. It remains to be seen whether there as a lower limit to the size of a transit agency where automation of data retrieval would be cost-effective. It is possible that the use of low-cost microcomputers or of automated voice response systems could be the solution for data retrieval in these small systems. In any case, it is clear that small agencies (200 buses or less) cannot afford and probably do not need sophisticated systems comparable to the SCRTD CCIS or WMATA AIDS.

At large agencies such as SCRTD and WMATA, the multiplicity of departments controlling various aspects of the transit data base will present problems to ATIS creation and implementation. The Marketing Departments at both these agencies had to struggle against entrenched data recording and updating practices in the schedules, stops, and planning departments of their respective organizations. The WMATA Project Manager made an important observation when he noted that internal politics cannot and should not be used as the ultimate justification for the creation of a unified transit data base. Rather, the data base should be "sold" to other departments on the basis of expected improvements to their internal operations as a result of its creation. At smaller

agencies, creation of "partial" ATIS data bases should prove less of a problem. For example, the MTC Planning and Scheduling Department's RUCUS files contained all the basic information necessary for the TIC.

Both the SCRTD and WMATA are only just beginning to realize the potential significance of their geographic and transit data bases as a valuable resource, not only to other transit agency departments but to the entire metropolitan area. These data bases could be leased out to various planning organizations for carpool/vanpool establishment, traveler information at transportation terminals such as airports/bus stations, and calculation of service assessments for local governments, etc. The transit agency can actually help pay for system implementation by leasing out access to the data base. The overall financial justification of comprehensive ATIS is therefore far greater than merely productivity increases and cost savings within the Telephone Information Departments. It is less obvious whether this situation holds true for "partial" ATIS deployments at smaller systems. At the MTC, the TIC is viewed largely as a "stand-alone" system.

In the opinion of management officials at the SCRTD, WMATA and MTC, the benefits achieved through ATIS deployment at their respective agencies have far outweighed the costs of system development and implementation. These benefits include not only tangible "dollars and cents" benefits such as increased productivity and elimination of the hard-copy update function. They also include less tangible, but no less important, benefits such as greatly improved information accuracy and consistency, enhanced agent job satisfaction, and a reduction in employee turnover. These results are the result of cooperation and hard work on the part of system designers, management, and agents. As one WMATA agent noted in an opinion survey response: "The system has proven...to be a very useful mechanism. The only improvements I would

suggest would be faster responses and sometimes not giving so many alternatives. Otherwise, Bravo Machine!!!"

APPENDIX A

A.1 SCRTD EVALUATION FINDINGS

With the full cooperation of SCRTD management, Wilson Hill Associates in the spring of 1980 began a comprehensive evaluation of the CCIS. The evaluation strategy developed by Wilson Hill was dependent on the SCRTD management approaches and institutional attitudes at that time toward system implementation. At the SCRTD, the major questions on the part of management were: "Is the system viable?; Can it actually be used for information retrieval?; If so, how well does it work?"

The viability question was the first focus of the evaluation. By monitoring agents at work, an attempt was made to discern performance differences between computer agents and those agents still using manual data retrieval methods. Several problems soon became evident in this approach:

- Agent efficiency is directly related to job experience, and there was a wide variation in experience levels.
- Since CCIS agents were still given the option of using manual methods as they wished, there was considerable variation in computer usage from agent to agent.
- Caller requests varied widely in terms of the amount of time required to provide the appropriate response.

In order to overcome these problems, an experiment was designed and carried out which carefully controlled the agent's environment and allowed as accurate as possible a measure of one system against another. This CCIS controlled experiment had the following characteristics:

- Three retrieval modes were tested: manual only, CCIS only, and mixed (manual or CCIS, or both at the agent's discretion);
- Three skill/experience levels: novice, intermediate and advanced;
- Standardized set of routing questions which taxed the agents' route-finding skills (asked in controlled order);
- Carefully controlled test environment - the experiment was unable to use the operators' work stations, due to the inflexibility of the telephone equipment, but a training room was used in which a standard work station was replicated;
- Agents were instructed to perform "normally", i.e., not to work as fast as possible, and that they were being tested in terms of accuracy as well as speed;
- Agent responses were timed and written down by the evaluation contractor;
- Accuracy was initially graded by an SCRTD supervisor and later by an impartial panel of SCRTD Planning Department employees.

Tables A-1, A-2 and A-3 present the more salient findings of this experiment. In Table A-1, the hourly call rate for each of the nine test agents is presented. As can be seen in this table, none of the agents were able to match the standard SCRTD hourly call rate of 20; the novice agents, with job experience of six months or less, were clearly slower than their intermediate and advanced counterparts. Some reasons for this relatively slow performance might be the complexity of the test questions or experimental effects which made the agents more nervous and cautious in researching responses.

TABLE A-1. AVERAGE CALL RATES FOR EACH TEST AGENT (IN CALLS PER HOUR)

AGENT SKILL/ EXPERIENCE LEVEL	MODE OF DATA RETRIEVAL		
	MANUAL	CCIS	MIXED
NOVICE	13.1	11.1	10.4
INTERMEDIATE	16.3	19.1	17.1
ADVANCED	15.3	19.9	15.9

Source: CCIS Controlled Experiment

TABLE A-2. RELATIVE FREQUENCY OF RESPONSE QUALITY GRADES RECEIVED GROUPED BY AGENT SKILL/EXPERIENCE LEVEL (% OF TOTAL FOR EACH GROUP)

GRADE ASSIGNED	EXPERIENCE/SKILL LEVEL		
	NOVICE	INTERMEDIATE	ADVANCED
USEFUL (S-6 to S-10)	73.1	78.7	86.1
MARGINAL (S-1 to S-5)	13.9	13.9	8.3
UNSATISFACTORY (U)	13.0	7.4	5.6

TABLE A-3. RELATIVE FREQUENCY OF RESPONSE QUALITY GRADES RECEIVED GROUPED BY MODE OF DATA RETRIEVAL

GRADE ASSIGNED	MODE OF DATA RETRIEVAL		
	MANUAL	CCIS	MIXED
Useful (S-6 to S-10)	77.8	76.9	83.3
Marginal (S-1 to S-5)	13.9	10.2	12.0
Unsatisfactory	8.3	12.9	4.7

Table A-1 shows that the CCIS was, on average, faster than the other two modes of information retrieval in the experiment. Table A-2 presents the relative frequency of accuracy grades received, grouped by agent skill/experience level, as a percentage of the total for each group. From this table, it can be seen that the advanced agents were considerably better at providing responses considered "useful" (those rated as "satisfactory" or "S"-6 to 10 by the graders; an "S-10" was considered the best response possible) by the graders than the intermediates or the novices. Table A-3 presents similar grade frequencies, this time grouped by mode of data retrieval. It can be seen from this table that the mixed mode agents using either CCIS or manual retrieval or both gave the most accurate responses followed by the manual only and the CCIS only agents.

Thus, the CCIS experiment confirmed to the SCRTD that the computer was indeed a viable mode of data retrieval. The CCIS was faster than the other modes of data retrieval, and while the mixed mode was the most accurate, back-checking of computer information against manual references slowed down mixed agent performance to well below minimum SCRTD standards for speed.

Once the experiment validated the usefulness of the CCIS, the SCRTD evaluation concentrated on a time-series data collection approach to gather quantitative performance data on the system in steady-state operation. In this performance evaluation, the built-in daily data summary capabilities of the CCIS proved particularly useful. These CCIS log file data were complemented by counts of total incoming calls and calls answered obtained through monitoring of telephone call distribution equipment

readings. Figure A-1 presents a time-series picture of one important performance statistic: the percentage of total incoming calls answered. Data are presented on this figure for both the CCIS agents (who handled only calls entering the Telephone Information Section on the "Van Nuys" trunk line serving the San Fernando Valley) and for the manual agents (who answered incoming calls on all the remaining trunk lines). Figure A-1 shows that the percentage of total calls answered fluctuated from week to week between 50 and 70 percent, with an average of approximately 60 percent for both manual and CCIS agents over the 14-week observation period.

Table A-4 presents average CCIS call times and standard deviations for each week of the observation period as obtained from daily CCIS log files. This table shows a general decline in average call times over the course of the observation period from 2:09 per call to 1:53 per call and a corresponding gradual increase in projected call counts from 28 to 32 calls per hour. The relatively high standard deviations in call times recorded are indicative of the wide variation in call durations.

Variation in CCIS call times is further displayed in Table A-5 and Figure A-2. Calls answered in one minute or less showed a gradual increase over the course of the observation period, while calls with durations of three or more minutes declined correspondingly.

These quantitative performance data present a fairly complete picture of center productivity and call characteristics, but they do not measure some equally

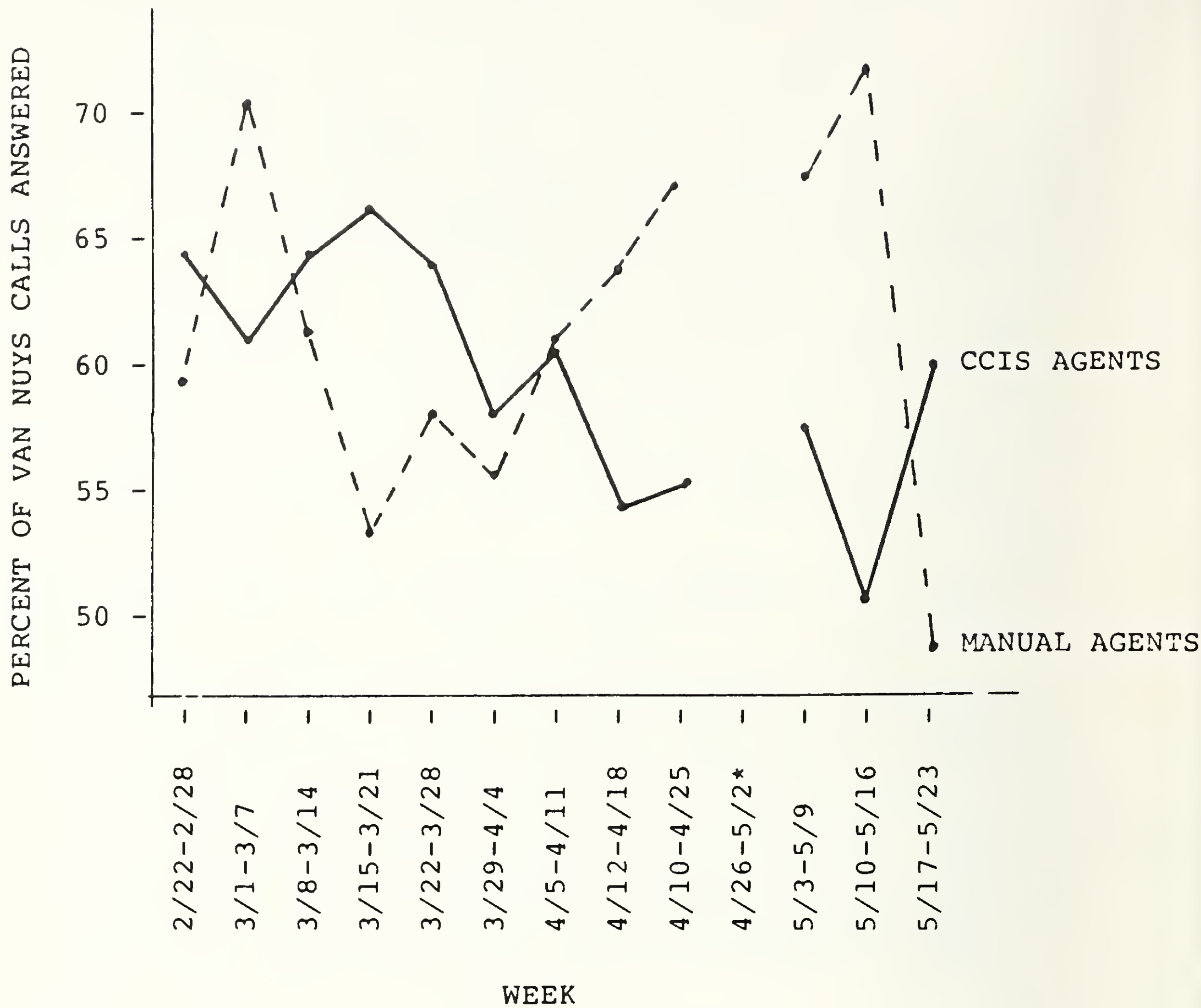

FIGURE A-1. DAILY PERCENTAGE OF ALL VAN NUYS TRUNK CALLS ANSWERED BY CCIS AGENTS (SOLID LINE) AND NON-VAN NUYS TRUNK CALLS ANSWERED BY MANUAL AGENTS (DOTTED LINE): AVERAGE FOR EACH WEEK OF THE TEST PERIOD

Source: ACD Trunk Group Readings

* Missing from CCIS Log File Data

TABLE A-4. AVERAGE CALL TIMES AND STANDARD DEVIATIONS FOR EACH WEEK OF THE TEST PERIOD

WEEK	AVERAGE CALL TIME	STANDARD DEVIATION
2/22 - 2/28	2:09	1:26
3/1 - 3/7	2:05	1:23
3/8 - 3/14	2:02	1:24
3/15 - 3/21	2:04	1:21
3/22 - 3/28	2:01	1:22
3/29 - 4/4	2:02	1:22
4/5 - 4/11	1:55	1:16
4/12 - 4/18	2:03	1:25
4/19 - 4/25	2:11	1:31
4/26 - 5/2*	*	*
5/3 - 5/9	1:55	1:20
5/10 - 5/16	1:56	1:28
5/17 - 5/23	1:56	1:18
5/23 - 5/30	1:53	1:15

* Missing from CCIS Log File Data

Source: CCIS Log File

TABLE A-5. CLASSIFICATION OF CCIS CALLS ANSWERED BY DURATION OF CALL

WEEK	LESS THAN ONE MINUTE	LESS THAN TWO MINUTES	LESS THAN THREE MINUTES	OVER THREE MINUTES
2/22-2/28	21.6	57.9	78.5	21.5
3/1-3/7	18.4	59.3	79.9	20.1
3/8-3/14	21.3	60.4	81.4	18.6
3/15-3/21	21.5	58.1	79.7	20.3
3/22-3/28	20.9	60.2	82.9	18.1
3/29-4/4	21.3	60.3	79.8	20.2
4/5-4/11	23.5	62.7	84.0	16.0
4/12-4/18	21.5	60.8	81.0	19.0
4/19-4/25	18.9	57.4	78.4	21.6
4/26-5/2*	*	*	*	*
5/3-5/9	24.7	63.9	83.9	16.1
5/10-5/16	24.2	63.2	84.1	16.0
5/17-5/23	23.4	62.5	83.0	17.0
5/24-5/30	25.3	64.5	83.8	16.2
AVERAGE	22.0	60.9	81.5	18.5

* Missing from CCIS Log File Data

Source: CCIS Log File

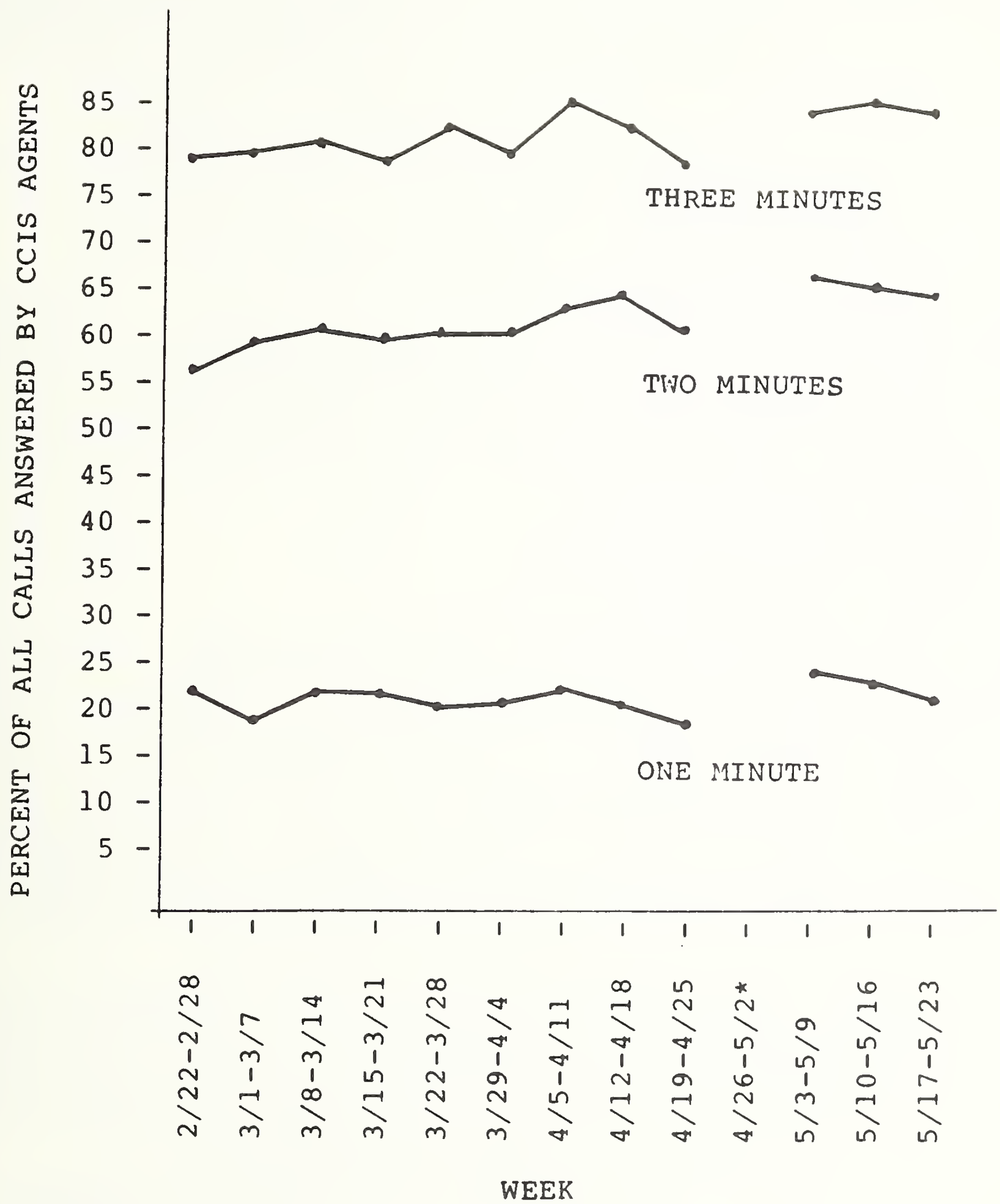

FIGURE A-2. PERCENTAGES OF CCIS CALLS ANSWERED HAVING DURATIONS OF ONE, TWO, OR THREE MINUTES OR LESS AVERAGES FOR EACH WEEK OF THE TEST PERIOD

Source: CCIS Log File
* Missing from CCIS Log File Data

important benefits of ATIS technology concerning information accuracy, job satisfaction, training time reduction, etc. This more qualitative data was impossible to derive from performance statistics. Instead, it was obtained through surveys and interviews of operators, supervisors, and management personnel involved in system implementation.

Agent questionnaires were administered twice in Los Angeles before and after the 90-day observation period. Types of data collected in these surveys included:

- Work experience
- ATIS experience
- Hourly call count
- ATIS influence on hourly call count
- Opinion of ATIS training
- ATIS influence on job satisfaction
- Problems using ATIS
- Comparison with manual retrieval over a broad range of different comparison categories
- Suggestions for system improvements

Types of data collected through supervisory and management personnel interviews included:

- History/problems of system implementation
- Training time reductions/benefits
- Agent attitude/productivity benefits
- Cost data
- Information spinoff uses and interdepartmental considerations

Table A-6 summarizes some of the data collected in these two questionnaires regarding agent opinions of the CCIS as opposed to normal data retrieval. Agents

TABLE A-6. CCIS AGENT COMPARISONS OF MANUAL VS CCIS INFORMATION PROCESSING FOR VARIOUS COMPARISON CATEGORIES (% OF TOTAL AGENT RESPONSES)

COMPARISON CATEGORY	RATING CATEGORY					
	BETTER		WORSE		SAME	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
RETRIEVAL SPEED	64	81	12	6	24	13
ACCURACY OF INFORMATION	40	77	12	3	48	19
DETAIL OF INFORMATION	52	71	16	0	32	29
ABILITY TO HANDLE MULTIPLE REQUESTS	48	55	32	26	20	19
MAKING JOB EASIER	80	84	12	0	8	16
PROVIDING SATISFACTION TO THE CALLER	24	58	12	6	64	35
OVERALL CAPACITY	60	77	16	0	24	23
PERCENT OF ALL RESPONSES	53	73	16	6	32	21
TOTAL AGENTS RESPONDING	25	31	25	31	25	31

were asked to compare the two systems in a number of different categories in a question that was identical in both surveys. Comparison of the "before" and "after" responses to this question may thus provide insights into changes in agent attitudes towards the system which may have developed during the course of the 90-day observation period. Table A-6 shows that the system management improvements implemented at the beginning of this period had a strongly positive effect on agent perception of the system's usefulness, particularly in the categories of "accuracy" and "caller satisfaction". Agents rated the CCIS much higher in the "after" survey; all 31 agents responding in the "after" survey rated the system "about the same" or "better" in the category of "makes job easier". The category "ability to handle multiple requests" received the most unfavorable rating overall, although a majority of agents still felt the CCIS was better in this regard.

A.2 ACHIEVEMENT OF SCRTD IMPLEMENTATION GOALS

A.2.1 Agent Productivity

Data collected during the course of the evaluation at SCRTD leads to rather conflicting conclusions concerning system influences on agent productivity. Under controlled experimental conditions, the intermediate and advanced CCIS agents were appreciably faster in producing responses to the test questions than were the manual and mixed mode agents. Similarly, projected call counts for CCIS agents on the CCIs log file averaged almost 30 per hour, a 50% increase over the SCRTD's manual standard of 20. Yet CCIS agents during the 90 day evaluation

period did not perform at this 30-per-hour figure, in which time spent between calls is assumed to be zero. Their overall percentage of calls answered vs. calls lost is quite comparable to that of the manual (non-Van Nuys Trunk) agents; both groups answered an average of about 60% of total incoming calls. In addition, their self-admitted call counts on both the agent "before" and "after" opinion surveys averaged approximately 20 per hour.

The conclusion to be drawn from these conflicting data, developed through consultation with the CCIS Program Manager, is that the system can indeed enable experienced agents to approach the rate of 30 calls per hour. The working styles of CCIS agents can be classified into two separate categories: agents in the first category tend to work at a relatively steady pace of slightly over 20 calls per hour, with brief breaks in between calls, while agents in the second category tend to work in brief spurts, handling a large number of calls in a brief period (at the 30 call per hour rate) and then taking extended breaks to "cool down". The end result of both styles is a call rate approximating 20 per hour. A prime advantage of CCIS over manual retrieval, the Program Manager noted, is that all CCIS calls, even those involving the most complex itineraries, are of relatively uniform length. CCIS agents are thus enabled, much more so than their manual counterparts, to develop a steady working pace. In the long run, the Program Manager stated, agent development of

typing and call management skills will produce gradual increases in this steady pace. The implication is that the CCIS raises the potential for increases in overall Information Section productivity.

A.2.2 Response Accuracy and Consistency

The CCIS data base was extremely large and complex, and problems encountered in its creation (digitizing street addresses, for example) left it filled with numerous "bugs". Similarly, software routines developed for itinerary selection initially made certain over-optimistic assumptions concerning appropriate walking distances, transfer times, etc. Over an extended period, refinements and corrections developed in consultation with Information Section management and in response to agent "trouble reports" have gradually reduced the accuracy problem to nearly zero.

Agent responses to the "before" and "after" surveys concerning system response accuracy show a decided shift towards acceptance of CCIS responses. In the "before" survey, only 10 agents felt that CCIS accuracy was better than manual, while 15 felt that it was about the same or worse. In the "after" survey, 24 agents felt that CCIS accuracy was better, while only 7 felt that it was about the same or worse. Results of the controlled experiment also show that agents using the CCIS produced responses that were graded at least as high on average as those of manual agents, and those using CCIS with manual backup (the mixed mode) produced the highest quality responses.

It cannot be overemphasized that the correction and enhancement process was an interactive one in which agents and Information Section management were active participants. This interaction not only resulted in greater accuracy of the data base and a more workable system, but also led to increased confidence on the part of the agents that the system was being designed to meet their individual needs. It is highly doubtful that this pilot demonstration would have enjoyed nearly the success that it has without the establishment of mechanisms to facilitate this interaction. The CCIS Working Committee, Program Manager, and the "trouble report" system are all examples of such mechanisms.

A.2.3 Agent Training

Interviews with Information Section management indicated that perhaps the greatest positive impacts exerted by the CCIS on the Section's operations would be in the area of agent training. By drastically reducing the need for agent memorization of geographical and route data, the standard agent training period can be cut at least in half. If trainees already possess typing skills, this period may be even shorter; the CCIS Program Manager cited the experience of training two Kelly Girl temporary employees to reasonable proficiency on the system in only one week.

This reduced training time has strong potential for benefits in the areas of improved personnel

recruitment and retention. The work force from which agents are recruited can be greatly expanded to include older and part-time employees, neither of which was suited for the rigorous traditional agent training course. The long-term implication of these training benefits is significant cost savings to the Telephone Information Section, although the data available makes these savings difficult to quantify.

A.2.4 Updating of Data Base

Another potential major improvement in Information Section Operations brought about as a result of CCIS implementation is the capacity to perform reference data base updating functions on a centralized basis. One full-time employee at a single terminal could perform the data base updating tasks presently performed almost full time by 15 supervisors. While manual references would probably not be eliminated entirely, in case of computer malfunctions, etc., their number would be greatly reduced from the 95 complete sets currently maintained by the supervisors.

A side benefit of centralized data base updating would be an improvement in the job of supervisor. At present, supervisors spend practically all their time performing update functions. As a result, their skills as agents tend to gradually diminish to the point where they are below those of less experienced agents. Centralized updating would free the supervisors to perform the functions

for which their jobs were originally created: troubleshooting and solving agent problems on the floor as they occur.

A.2.5 Agent Job Satisfaction

CCIS agent responses to the "before" and "after" surveys show conclusively that implementation of the CCIS has led to an increase in agent job satisfaction.

The implication of these survey results is that a sizable percentage of agents felt that CCIS influenced their job positively, and that this percentage showed an increasing trend over the course of the evaluation period. One agent summarized the influence of CCIS on her job rather humorously: "I don't have to <u>work</u> anymore; I can just <u>talk</u> all day."

A.2.6 Data Collection

The development of the CCIS log file as a data collection tool during the course of the system evaluation demonstrated clearly the ability of the system to keep accurate records on all aspects of system performance. Far more data is now available to Information Section management concerning the performance of each CCIS agent and of the entire system than was previously available with the less reliable ACD data. Furthermore, expanded data collection frees the Senior Supervisor from a great deal of paperwork involving ACD counts, time sheets, etc. and gives her more time to work with the supervisors and agents on the floor.

A.2.7 Integration with Other Departments

Although a CCIS Working Committee has been established for the purpose of inter-departmental coordination of CCIS activities, the full benefits of a totally integrated data base incorporating stops, zones, routes, and schedules have yet to be fully realized at the SCRTD. This situation is the result of several factors:

- The CCIS is currently limited to the San Fernando Valley in its pilot demonstration;
- The Stops and Zones and Scheduling Departments currently use their own data processing systems which are incompatible with the Univac 1106 supporting the CCIS;
- Management of the SCRTD departments appear to have little detailed knowledge of the characteristics or potentials of the CCIS.

APPENDIX B

B.1 WMATA EVALUATION FINDINGS

At WMATA many of the same evaluation steps were taken as were taken at SCRTD, but again institutional attitudes played an important role in determining the overall evaluation strategy.

At WMATA, the general attitude towards ATIS implementation was one in which the Office of Marketing was "sold" on the idea from the outset. The prevailing question was not so much "Can it work?" as "How well are the operators making use of the system?" In determining responses to this question, Wilson Hill was able to use a "before-after" approach in data collection procedures. When the system evaluation began, the design contractor was still putting the system through its acceptance testing. As a result, a considerable amount of quantitative data were gathered before startup through call monitoring and compilation of telephone answering system statistics. A round of interviews was also completed concerning management expectations of the system, and an operator opinion questionnaire was designed and administered. Approximately 9 months later, once the system was implemented and almost all operators were trained in its use, the data collection process described above was repeated except that this effort was also supplemented by computer log statistics.

Tables B-1 and B-2 present agent performance data as collected by the AIDS daily log file. In Table B-1, it can be seen that AIDS is used most frequently by the agents for itinerary-type requests, which account for 83% of all system processing transactions. Schedule

TABLE B-1

PERCENTAGES OF AIDS FUNCTIONS PROCESSED BY TYPE
(AVERAGES FOR EACH WEEK OF DATA COLLECTION)

WEEK (1981)	FUNCTION TYPE			
	ITINERARY	SCHEDULE	ROUTE	FARE
Oct. 5-11	85	11	0	4
Oct. 12-18	81	14	1	4
Oct. 19-25	84	11	0	5
Oct. 25-Nov. 1	84	10	0	6
Nov. 2-8	85	10	0	5
Nov. 9-15	85	9	0	6
OVERALL AVERAGE	83.61	11.08	0.35	5.15
ON AVERAGE, ONE CALL IN EVERY	1.20	9.00	285.70	19.41

Source: AIDS Log Files

TABLE B-2

CHARACTERISTICS OF AIDS USAGE
(AVERAGES FOR 6-WEEK PERIOD, FIGURES SHOWN PER HOUR LOGGED-ON)

DAY OF WEEK	TOTAL KEYED FUNCTIONS	TOTAL "ERRORS" REPORTED	TOTAL VALID TRANSACTIONS	RATIO OF VALID/ TOTAL
MONDAY	9.37	3.97	5.40	57.6%
TUESDAY	9.89	3.54	6.35	64.2%
WEDNESDAY	9.70	3.81	5.89	60.7%
THURSDAY	7.82	3.27	4.55	58.2%
FRIDAY	8.43	3.40	5.03	59.7%
SATURDAY	8.67	3.80	4.87	56.2%
SUNDAY	7.40	3.64	3.76	50.8%
OVERALL AVERAGE	8.69	3.72	4.97	56.7%
OVERALL STANDARD DEVIATION	1.89	0.72	0.63	6.9%

Source: AIDS Log Files

transactions account for another 11% of computer processing time, while fare requests use another 5%. The remaining 1% is used for route description requests. This breakdown is rather expected since it reflects the relative frequencies of inquiry types received, and since itinerary requests require the most manual reserach on the part of the agent, while manual schedule references are a relatively straightforward process. Agents who have undergone the full WMATA training program (all but four of the agents during data collection) would be expected to know most route descriptions and fares from memory.

The AIDS log file also keeps track of agent "errors", which can be attributed either to agent misspellings, input format errors, or caller misinformation. As can be seen in Table B-2 these errors occurred at the rate of approximately four per hour logged-on, on average. Thus, valid transactions which yielded useful data to the agent (and the caller) occurred at a rate of just under five per hour, on average. This implies that 43% of all data entries, or one keyed transaction out of every 2.31 entries, results in a system error response. While this percentage may appear to be unacceptably high, it should be emphasized that caller errors account for some of these responses. With increasing agent experience, it should be expected that this "error" rate will decrease.

Tables B-3, B-4 and B-5 present results obtained in after-implementation call monitoring at WMATA. Table B-3 presents a cross-tabulation of call time vs. data retrieval mode for all 1341 calls monitored. As can be seen from this cross-tabulation, manual retrieval-only calls are generally of short durations; 85% of these calls take less than two minutes to complete, while 61% take less than one minute. AIDS-only and mixed-mode

TABLE B-3

CROSS-TABULATION OF CALL TIME VS DATA RETRIEVAL MODE AFTER IMPLEMENTATION CALL MONITORING

CALL TIME (SECONDS)	MODE OF DATA RETRIEVAL				TOTAL
	MANUAL ONLY	AIDS ONLY	AGENT MEMORY	MIXTURE OF MODES	
0 - 30	180	5	82	7	274
30 - 60	235	21	63	18	337
60 - 90	115	63	20	22	220
90 - 120	51	56	11	23	141
120 - 180	66	88	8	32	194
180 - 240	19	37	2	28	86
240 - 300	8	26	2	12	48
300 - 360	2	14	0	7	23
Over 360	3	6	0	9	18
TOTAL	679	316	188	158	1341
PERCENT OF TOTAL	50.6	23.6	14.0	11.8	

TABLE B-4

CROSS-TABULATION OF QUERY TYPE VS RETRIEVAL MODE CHOSEN AFTER IMPLEMENTATION CALL MONITORING

QUERY TYPE	MODE OF DATA RETRIEVAL				TOTAL
	MANUAL ONLY	AIDS ONLY	AGENT MEMORY	MIXTURE OF MODES	
ITINERARY	325	264	164	133	886
SCHEDULE	316	31	14	12	373
ROUTE	0	1	0	0	1
FARE	38	20	10	13	81
TOTAL	679	316	188	158	1341

TABLE B-5

CROSS-TABULATION OF CALL TIME VS QUERY TYPE AFTER IMPLEMENTATION CALL MONITORING

CALL TIME (SECONDS)	QUERY TYPE				TOTAL
	ITINERARY	SCHEDULE	ROUTE	FARE	
0 - 30	116	140	0	17	273
30 - 60	195	144	0	25	364
60 - 90	140	43	0	13	196
90 - 120	115	25	0	7	147
120 - 180	156	12	0	13	181
180 - 240	77	6	0	5	88
240 - 360	68	2	1	1	72
Over 360	19	1	0	0	20
TOTAL	886	373	1	81	1341
PERCENT OF TOTAL	66.07	27.81	.08	6.04	

calls have flatter time distributions, and average around two minutes in duration. As might be expected, the great majority (77%) of memory-only calls take less than one minute, since no data retrieval time is required. Table B-4 depicts the cross-tabulation of query type versus mode of data retrieval chosen. As can be seen from this table, the vast majority (85%) of schedule queries prompt agents to use manual retrieval. On the other hand, 84% of all AIDS-only calls are itinerary requests. In Table B-5, a cross-tabulation of call times vs. query types is presented. This table reinforces the finding that schedule requests are generally handled in rapid fashion, while itinerary and fare requests usually take longer.

Table B-6 presents a summary of agent opinions concerning the performance of AIDS, as opposed to manual retrieval, across a number of comparison categories. From this table, it can be seen that WMATA agents are, on the whole, quite favorably disposed to the system. The AIDS system was rated "better" in 97 agent responses, or 53.5% of the total, and "about the same" in an additional 67 responses, or 36.8%. Only 13 responses characterized AIDS as "worse" than manual (7.18% of the total). Particularly strong positive showings for AIDS came in the categories of "detail of information" and "making job easier". The strongest negative comparison came under the category "speed of retrieving information", in which 16 agents felt manual retrieval was about the same or better than AIDS.

TABLE B-6

AGENT COMPARISONS OF AIDS VS MANUAL DATA RETRIEVAL METHODS
AFTER IMPLEMENTATION AGENT SURVEY

COMPARISON CATEGORY	AGENT RESPONSES		
	AIDS BETTER THAN MANUAL	AIDS WORSE THAN MANUAL	AIDS ABOUT THE SAME AS MANUAL
SPEED	9	6	10
ACCURACY	11	2	11
DETAIL	20	1	5
JOB FATIGUE	9	1	15
MULTIPLE QUERY	14	2	9
MAKE JOB EASIER	20	0	6
CALLER SATISFACTION	14	1	11
TOTAL	97	13	67
% OF ALL RESPONSES	53.3	7.1	36.8

Before-after implementation comparisons of WMATA agent performance data are presented in Figure B-1 and Tables B-7 and B-8. The frequency distributions in Figure B-1 display evidence that system implementation raised the total number of calls handled in one minute or less and correspondingly decreased the number of calls handled in over four minutes. Table B-7 presents the statistics to support this graphic evidence.

Table B-8 compares agent use of various available reference materials before and after AIDS implementation. As can be seen from this table, agent memory accounted for approximately 15% of all responses both before and after implementation. The computer, however, has replaced manual data reference use for between 25 and 30 percent of all calls handled.

B.2 ACHIEVEMENT OF WMATA SYSTEM IMPLEMENTATION OBJECTIVES

B.2.1 Agent Productivity

Data collected during the course of the evaluation led to rather conflicting conclusions regarding system influences on operator productivity. Agents were rather evenly divided on the after-implementation questionnaire regarding AIDS influence on call counts, and a number of them complained about system response speed. Furthermore, ACD data revealed a slight decrease in Information Section productivity post-implementation. In contrast, agents were almost unanimous in the opinion that AIDS made their jobs easier, and routine performance tests reveal that operators using AIDS are capable of answering calls at the rate of 30 to 40 per hour, a 30% increase over their normal manual speed.

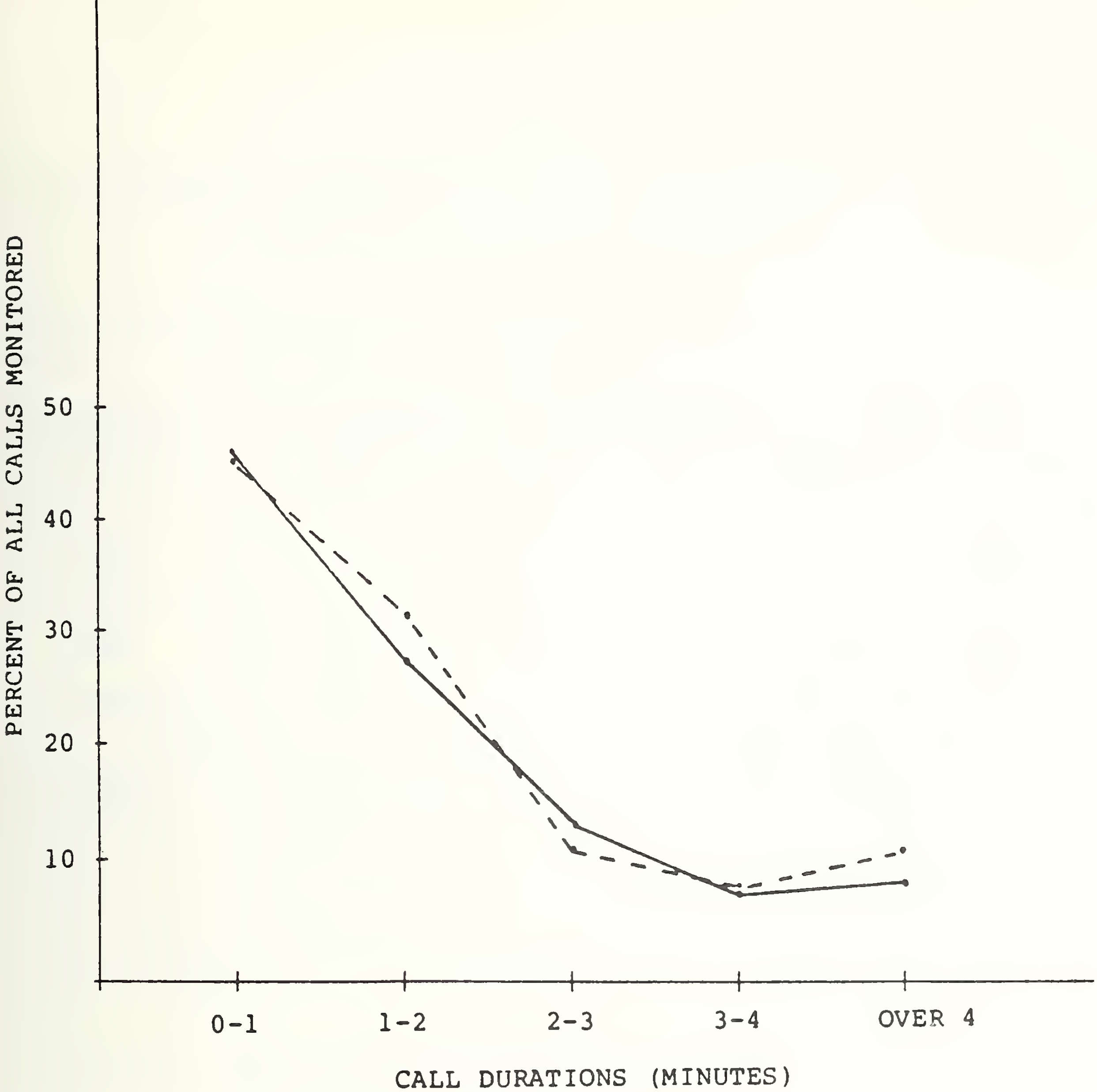

FIGURE B-1
FREQUENCY DISTRIBUTION OF CALL TIMES,
BEFORE (DOTTED LINE)
AND AFTER (SOLID LINE) IMPLEMENTATION

Source: WHA Call Monitoring

TABLE B-7

CALL TIME FREQUENCIES BEFORE AND AFTER AIDS IMPLEMENTATION
(PERCENT OF ALL CALLS ANSWERED)

CALL TIME (SECONDS)	BEFORE IMPLEMENTATION	AFTER IMPLEMENTATION	DIFFERENCE
0 - 60	42.1	45.6	+3.5
60 - 120	31.7	26.9	-4.5
120 - 180	13.2	14.5	+1.3
180 - 240	5.4	6.4	+1.0
OVER 240	7.6	6.6	-1.0

Source: WHA Call Monitoring

TABLE B-8

DATA SOURCES CONSULTED BY AGENTS
BEFORE AND AFTER AIDS IMPLEMENTATION

(FREQUENCY OF USE, PERCENT)

DATA SOURCE	BEFORE IMPLEMENTATION	AFTER IMPLEMENTATION	DIFFERENCE
MANUAL ONLY	85.4	50.6	-34.8
COMPUTER ONLY	*	23.6	+23.6
MIXTURE OF SOURCES	*	11.8	+11.8
AGENT MEMORY	14.6	14.0	-.6

* Did not exist before implementation

Source: WHA Call Monitoring

WMATA supervisory and management personnel were able to shed some light on the reasons underlying these conflicting results. It appears that at current system response speeds, schedule questions are still handled fastest manually; this fact is supported by call monitoring data. Thus, agents who use the computer for nearly every call are actually less productive overall than those who use it more selectively. Varying agent experience levels are also a factor since newer agents tend to rely on computer or manual references more than their more experienced counterparts, who rely more on memory. Answering from memory is much faster since no data retrieval is involved. Supervisory personnel indicated that very experienced operators (having 10 or more years on the job) are able to answer up to 75% of their calls from memory. These operators tend to use AIDS only for calls requiring construction of long or complex itineraries. It is not surprising, then, that more experienced operators would feel that using the computer would slow them down in most instances, but would still be of the opinion that AIDS made their jobs easier (for the more complex queries).

Supervisory personnel indicated that they were initially discouraged by agent call counts following AIDS training. When they made it clear to the agents that using AIDS was not necessarily the most useful or efficient way to respond to every single call, agent productivity increased considerably, usually to levels above previous averages for manual data retrieval. Management and supervisors

both felt that a 50-50 balance between computer and manual data retrieval produced the highest overall call count for the average agent. Monitoring data show that this balance has not yet been achieved; the computer is currently used for 25-30% of all calls.

B.2.2 Response Accuracy and Consistency

Agents were quite unanimous in their opinions that AIDS responses were more accurate and had a greater level of detail than manual responses. Supervisory personnel stated that the problem of misinformation, while affecting a relatively small percentage (1-2%) of all calls, was greatest with inexperienced operators using manual materials only. Supervisors indicated that they felt much more comfortable when these operators consulted AIDS.

One feature of AIDS that helps ensure the near 100% accuracy of its data base is the built-in error-reporting function. If an operator receives a response that he/she deems questionable, activating the reporting function will cause the response to be listed, along with the agent's ID number, on a daily "trouble report". A review of this report by agents and management helps locate inconsistencies or errors in the data base, as well as to identify areas in which an agent's training might be deficient. It cannot be overemphasized that this enhancement process is an interactive one in which agents and Information Section management are active participants.

This interaction not only results in greater accuracy of the data base and a more workable system, but also leads to increased confidence on the part of the agents that the system is being changed to meet their individual needs.

B.2.3 Agent Training

In contrast to the Los Angeles experience, interviews with Information Section Management indicated that anticipated savings of training time for operators might not be achievable, based on results with four new agents. These agents received a two-week course which included computer instruction, communications skills development, and some rudimentary background in use of manual references (they already possessed typing skills). They were not given the intensive geographic and transit system practice which forms a major part of traditional manual training. After two weeks, these agents were producing "acceptable" call counts of 80-90 per day, and it seemed as though the training reduction benefit was achieved.

Reports from supervisory personnel, however, soon produced evidence to the contrary. Without the geographic and transit system practice, these new agents were unable to provide details to callers concerning landmarks to watch for during their journeys. Even worse, they were unable to make interpretive judgments between the four feasible alternative responses routinely produced by AIDS. In the opinion of the supervisors, they became too dependent on the computer for "simple" questions,

such as fare and schedule requests, which other agents would have handled manually or from memory. To remedy these observed deficiencies in their performance, these agents were later given additional training emphasizing map work and manual schedule practice. With this additional training, these agents were better able to picture routes, intersections, and landmarks, and achieved full proficiency (150-170 calls per day).

The net result of this experience was to point out that agents with AIDS training, but lacking a good grounding in manual practice and geographic data manipulation, are of marginal value. While these operators could be used as a stop gap measure during periods of critical manpower shortage, their long-term usefulness is limited at best.

B.2.4 Updating of Data Base

It is important to recognize that the geographic and transit data bases, once established, are not static. Rather, they must be constantly changed to reflect changes in local land use and in transit service. Making these changes requires the full-time effort of one employee. They are made so frequently that the AIDS geographic data base is becoming recognized as the most accurate address directory available for the D.C. metropolitan area.

B.2.5 Agent Job Satisfaction

All data collected during the evaluation on the subject of AIDS influence on agent job satisfaction

point to the fact that AIDS was well-received by agents. In the before-implementation survey, 73% of the agents responding chose "excellent" or "good" to describe their job satisfaction; after implementation, this percentage had risen to 85%. On the after-implementation questionnaire, agents were asked to rate AIDS influence on their job satisfaction. To this question, 76% replied "positive influence" and the remainder replied "no influence". None of the responding agents responded "negative influence".

B.2.6 Performance Statistics

The AIDS software as implemented contains a number of features which enhance system usefulness as a data collection tool. These features are currently being routinely used by supervisory and management personnel to monitor individual agent as well as system performance. Since implementation, there has been a dramatic increase in both the quantity and quality of these performance data. Unfortunately, however, some items are still lacking, because AIDS stores information concerning computer transactions only, and manual calls remain undocumented. Consideration might be given to modifying system software in such a way that a more detailed version of ACD telephone data could be stored in AIDS directly from the ACD equipment. In this way, all calls would be fully documented, and supervision would be relieved of the job of recording ACD data manually.

B.2.7 Interdepartmental/Spinoff Use

AIDS implementation has raised potentials for interdepartmental cooperation within WMATA on a scale not heretofore realized. Examples of potential cooperative efforts are as follows:

- The WMATA Scheduling Department has benefited from standardization and storage of its data on word processing equipment. While this standardization and storage effort was a necessary expenditure for the establishment of the AIDS transit data base, the Scheduling Department continues to enjoy costs savings as a result each time schedules are updated.
- The AIDS transit data base was used as a resource by the WMATA Planning Department in the recent implementation of the RUCUS run-cutting and driver scheduling system. It is estimated that having this transit data fully organized saved WMATA over $50,000 in implementation costs for RUCUS.
- The WMATA Planning Department can also make use of the AIDS Daily Log File as a planning resource. For example, origins and destinations of all itinerary calls can be superimposed against a system route map to determine whether service is adequate in areas with high information demand. Frequency of demand for information on certain bus routes can be compared with frequency of service on these routes.
- The WMATA Bus Stop Department can make use of AIDS in its ongoing program of providing information on Metro-Bus Stops. AIDS data can be used to document which bus routes pass a given stop.

- The WMATA Accounting and Finance Department can use the AIDS transit data base as a resource in calculating the number of passenger route-miles provided by WMATA to each of the various local jurisdictions in the service area. Using the data base in this fashion would greatly simplify these calculations, which form one basis for WMATA's operating subsidy assessments.

AIDS implementation has also raised the potential for other non-WMATA agencies to make use of the system. Examples of such "spinoff" possibilities are:

- Use of the geographic data base by the Federal Government or other jurisdictions as a resource in shared-ridership or car pool assignment programs.
- Provision of the geographic data base as a planning resource to local governments. It is generally recognized that this data base is the most accurate street address directory of the Washington, D.C. metropolitan area in existence. The D.C. Council of Governments has already expressed a willingness to pay for use of this geographical data base.
- Provision of remote AIDS terminals at local transportation centers for use by the general public. Such centers might include the larger METRO stations, National and Dulles Airports, local universities, etc.

Thus, the implementation of AIDS and the concomitant establishment of its various data bases have created a significant resource which has strong potential for serving a number of users besides information

operators and callers. The overall financial justification of the system is therefore greater than merely productivity increases and cost savings within the WMATA Office of Marketing. According to the AIDS Program Manager, the tangible and non-tangible benefits created by AIDS have already greatly outweighed its overall cost to the Authority.

APPENDIX C
MTC EVALUATION FINDINGS

C.1 INTRODUCTION

After system evaluation activities at SCRTD and WMATA were completed, TSC officials managing the ATIS assessment program approved the evaluation of a third deployment at the Metropolitan Transit Commission (MTC) in Minneapolis-St. Paul. This ATIS, known as the Transit Information Computer, or TIC, had actually been implemented at approximately the same time as the CCIS at SCRTD and the AIDS at WMATA. Because it was developed locally under the sponsorship of a funding source within UMTA separate from the SCRTD and WMATA demonstrations, the TIC was not widely publicized, and TSC officials became aware of its existence only after it had been in full operation for over a year.

The decision to evaluate the MTC ATIS was based on two major factors. First, it was developed at relatively low cost: for less than $250,000, including hardware procurement, the MTC had developed automated retrieval capacity covering its entire 57-municipality service area, including the downtown cores of Minneapolis and St. Paul. Second, the MTC was fairly small in comparison to the transit agencies sponsoring previous ATIS demonstrations. It operates only 830 peak hour buses as opposed to approximately 2500 for both SCRTD and WMATA. Evaluation of the MTC ATIS thus afforded an opportunity to judge the applicability of automated data retrieval technology in the context of a medium-sized agency, not an industry giant like SCRTD and WMATA. For this reason, inclusion of the MTC ATIS in the UMTA/TSC evaluation program was expected to add a valuable dimension to overall results that was not available from SCRTD and WMATA findings.

C.2 SYSTEM DEPLOYMENT HISTORY AND FUNCTIONAL CHARACTERISTICS

In 1978, the Transit Inquiry Center of MTC's Marketing Department exhibited many of the characteristic problems inherent in a traditional manual reference-based telephone information operation. Caller demand was rising to levels of over 100,000 calls per month. Due to across-the-board budget and service cutbacks, management was forced to reduce the telephone information agent work force from 46 to 33. The relatively frequent schedule changes (once every 4 to 6 weeks) adopted by the MTC placed a heavy burden on information center management to update hard-copy schedule data. Average wait time for callers before reaching an agent was increasing, and the number of "lost" or "abandoned" calls was also increasing. MTC Marketing officials were convinced that actions to improve productivity should be taken.

When Federal funding for information center improvement was obtained, management was initially interested in microfiche storage of hard-copy data. A survey of such equipment at the Chicago Transit Authority (CTA), however, convinced MTC officials that it was not the solution to their problems. The CTA microfiche readers had poor reliability records, and reducing the size of manual references to microfiches did little or nothing to improve the updating problem. As a result, MTC officials turned their attention to computer retrieval systems.

It was at this stage of system development that MTC management reached a key decision: the Transit Inquiry Center (TIC) would not incorporate digitized geographic data. This decision was made for a variety of reasons. The MTC service area is quite large, and two-thirds of the 57 municipalities it encompasses have their own street address systems. Raw data, such as U.S. Census DIME files, were not of high enough quality in most instances to be directly transferable

to a geographic data base for the ATIS. As a result, production and eventual maintenance of a digitized geographic data file would entail a sizable expense, probably more than the entire TIC project budget. Finally, it should be emphasized that MTC officials were aware of the problems encountered in geographic data base creation at WMATA and SCRTD, and wished to avoid repeating them.

The decision not to create a geographic data base had profound consequences on the eventual characteristics of the MTC system. Without geographic data, no automated itinerary responses ("To get from Point A to Point B, do the following...") were possible. The major function of the TIC, therefore, would be to provide schedule and headway information to telephone information agents. MTC officials were therefore confident in the training and ability of their information agents to select appropriate routes and itineraries. No reduction in agent training in these areas was anticipated through ATIS implementation.

As ultimately configured, the TIC system has a Texas Instruments 90-Series minicomputer as a central processor with 12 terminals (one terminal is reserved for supervisory updating). Data retrieval is prompted by five basic functional requests:

- Headway/Schedule data by bus route and direction of travel;
- Park-and-Ride lot locations by bus routes served;
- Bus stop passenger shelters by bus routes served;
- Activity Centers (Schools, Hospitals, Public Buildings, etc.) arranged in an alphabetic list by function;
- Daily Bulletins (cancelled runs, etc.) for telephone information agents, entered by supervisory personnel.

Of these five functions, the first is used over 99% of the time. In the headway function, agents can "scroll" up and down schedule "pages" on their response screens, and

can reverse directions for return trip requests. A built-in "print screen" function will save as hard copy any responses judged to be erroneous or questionable by agents. System response time is almost instantaneous; usually less than two seconds, even when all terminals are in use.

The MTC was able to take advantage of another significant cost-saving factor during system implementation. The MTC's Planning and Scheduling Department had already developed a RUCUS computerized run-cutting/scheduling system data base which was consistent and comprehensive. As a result, all schedule data was already in magnetic tape storage. Provision of this schedule data to the TIC therefore involved a comparatively low-cost conversion of the RUCUS files, and did not involve "starting from scratch" with hard-copy scheduling data. In total, TIC system data base development cost approximately $10,000.

System software for the TIC was developed between 1978 and 1980 by SCAMP, Inc., a local consultant. It should be noted that implementation of the TIC in the Transit Inquiry Center was almost concurrent with implementation of a prototype telephone system developed by WESCOM, Inc. This telephone system incorporates state-of-the-art microcomputer technology and represents a significant advance in sophistication over the MTC's previous system, which was similar to the Automatic Call Distribution Systems in use at SCRTD and WMATA. Besides handling the call distribution and counting functions performed by the previous system, the WESCOM system provides extremely detailed statistics on individual agent and information center performance. The system is capable of monitoring the percentages of time which an agent spends "vacant" waiting between calls, "in talk time" actually responding to customers, and "in call work" listening to caller requests. The MTC is thus slightly ahead of both SCRTD and WMATA in the ability to gather such statistics. While the ATIS deployments at

the two larger systems gather detailed performance data, these data concern only calls in which ATIS transactions are conducted. Calls handled manually or from memory are not analyzed and tallied by these systems. At the MTC, the WESCOM system generates reports on all calls, regardless of the data retrieval method chosen by the agent.

C.2 EVALUATION APPROACH AND FINDINGS

In comparison with system assessment efforts undertaken at SCRTD and WMATA, the MTC portion of the UMTA/TSC evaluation program was quite limited. Due to budget constraints, on-site data collection was limited to one visit to the Transit Inquiry Center from February 1-4, 1983. During this visit, a number of interviews of system managers and programmers were conducted and a variety of automated performance data were gathered. Agents were observed at work using the system, and were interviewed during their lunch breaks. Thus there were no long-term or systematic data collection programs established as at WMATA or SCRTD. Fortunately, however, the MTC has done in-house analyses of costs and benefits of system implementation which were made available to the evaluation contractor.

Persons interviewed included:

- MIS Coordinator
- Systems Programmer
- System Supervisors
- Senior System Supervisor
- Training Supervisor
- Information Agents

Table C-1 presents a summary of caller demand and the Transit Inquiry Center's performance in meeting that demand during February 1983. This table shows that demand peaks on Monday and Tuesday at about 3800 calls per day and tapers off through the rest of the week to a low of about 2500

TABLE C-1. MTC TRANSIT INQUIRY CENTER PRODUCTIVITY DATA

JANUARY 1983

DATE	CALLS RECEIVED	CALLS ANSWERED	CALLS LOST	% ANSWERED
S 1	2663	2291	372	86.0
S 2	2721	2175	546	79.9
M 3	3848	3202	646	83.2
T 4	3790	3128	662	82.5
W 5	2303	1590	713	69.0
T 6	3862	3268	594	84.6
F 7	3982	3512	470	88.2
S 8	3153	2594	559	82.3
S 9	2550	2232	318	87.5
M 10	4078	3539	539	86.8
T 11	3999	3548	415	89.6
W 12	3795	3318	477	87.4
T 13	3859	3553	306	92.1
F 14	3882	3564	318	91.8
S 15	3047	2555	492	83.9
S 16	2554	2280	274	89.3
M 17	3655	3264	409	89.3
T 18	3849	3405	444	88.5
W 19	3705	3198	507	86.3
T 20	3436	3096	340	90.1
F 21	3216	2806	410	87.3
S 22	3137	2817	320	89.8
S 23	2418	2087	331	86.3
M 24	3436	2812	624	81.8
T 25	3493	2814	679	80.6

TABLE C-1. CONTINUED...

DATE	CALLS RECEIVED	CALLS ANSWERED	CALLS LOST	% ANSWERED
W 26	3501	2752	749	78.6
T 27	3871	3304	567	85.4
F 28	3578	2874	704	80.3
S 29	3048	2308	740	75.7
S 30	2392	1851	541	77.4
M 31	3739	3103	636	83.0
AVERAGE	3373	2867	506	84.6
STANDARD DEVIATION	541	541	142	5.0

daily calls. The average daily call demand for the month was 3373, with a standard deviation of 541. On average, MTC agents answered 2867 calls per day, or just under 85% of total demand, with a standard deviation of 5%.

Table C-2 summarizes an analysis conducted in-house by MTC management in August, 1981 concerning costs and benefits of ATIS deployment. This analysis shows that agent productivity has increased 11.7% as a result of TIC implementation, which translates in dollar terms to a savings of $27,500 per year. In addition, an annual savings of $62,500 has been calculated for elimination of hard-copy reference updating. Given a total system development cost of $228,500, the cost/benefit ratio of the TIC is 3.0. It would therefore take three years for the system to pay for itself, based on this ratio.

In two complete days of observing MTC information agents at work, the following statistics were collected:

- Agents are asked to provide full itinerary (origin to destination) responses only about 20-30% of the time.

- Computer transactions are processed on about 60% of calls. Virtually all of these transactions involve schedule data.

- Agents can respond to approximately 30% of calls from memory without consulting TIC or other references.

- Wall maps showing streets and bus routes are consulted on approximately 50% of all calls.

- Agents provide very personalized responses which include walking instructions, landmarks to watch for enroute, etc.

This full itinerary percentage compares with 70-80% at WMATA. However, this smaller percentage may be expected intuitively in smaller metropolitan areas having less complex transit systems, where a typical transit rider may have greater knowledge of itinerary information.

TABLE C-2. COST/BENEFIT ANALYSIS OF TIC DEPLOYMENT AT MTC

COSTS		BENEFITS	
INITIAL:		INITIAL:	
Design	$14,500		
*Equipment (computer, terminals, and interface)	203,800		
RUCUS Interface	4,500		
Data Conversion	3,700		
Training	900		
Testing	1,100		
Total Initial Costs:	$228,500		
ANNUAL:		ANNUAL:	
*Equipment Maintenance	$10,000	** Hard Copy Update Savings	$62,500
Software Update	4,000	Increased Productivity	27,000
Total Annual Costs	$14,500	Total Annual Savings	$90,000

* Telephone equipment upgrade was separately funded and is not included in these figures.

** Due to elimination of non-computer-generated hard copy data.

Total Annual Benefits = $90,000

Total Annual Costs = 14,500

Net Annual Benefit $75,500

Cost/Benefit Ratio = $228,500/$75,500 = 3.03

C.1 ACHIEVEMENT OF MTC SYSTEM IMPLEMENTATION OBJECTIVES

C.3.1 Agent Productivity

Based on a comparison of Transit Inquiry Center calls handled in May 1980 (before implementation) and May 1981 (after implementation), average call length, after adjustment for discrepancies in man-hours worked, decreased from 200.3 seconds to 179.3 seconds. This decrease translates into a productivity increase from 17.97 calls to 20.08 calls per hour per agent, including break time between calls. If this productivity increase can be estimated as 10%, then, applying this figure to a $275,000 annual payroll for information agents yields an annual savings of $27,500 to the MTC due to system implementation.

These benefits were not experienced in the early months of system development as information agents struggled to cope with changes in routine caused both by new telephone equipment (the WESCOM system) and by new data retrieval equipment (the TIC). Initial call productivity fell sharply below previous manual averages, but after 6 to 8 months, the agents had acclimated themselves to the new workstyles dictated by these new systems. Most agents were able to surpass their previous manual call counts by a considerable margin.

C.3.2 Response Accuracy and Consistency

Both supervisors and agents agreed unanimously that response accuracy had improved tremendously as a result of system implementation. Some supervisory personnel indicated that they considered this increased accuracy a far more important benefit than any productivity

increases caused by the system. Under manual operation, an accuracy goal of 95% was established, but rarely achieved, according to system managers. Now, under automated retrieval, agents proofread the RUCUS files before they are reformatted onto the TIC. Responses judged by agents to contain errors can be printed out on a supervisory terminal for further investigation. As a result of these actions, system managers indicate that accuracy of the TIC data base is approaching 99%. Accuracy is extremely important to the TIC, as a missed transfer in the Minneapolis winter can be a very serious matter indeed.

C.3.3 Agent Training

Due to the fact that the TIC data base does not contain any digitized geographic information, the training program for new agents still places heavy emphasis on memorization of streets and bus routes. Agents spend a significant portion of the 8-week training session in drills and reviews of geographic data. As a result, implementation of the TIC did not provide the training reduction benefit enjoyed by the SCRTD. In fact, computer practice actually added to the length of the standard agent training program. The Training Supervisor at MTC did not consider this a negative aspect of the system, however; even under previous manual operation, an agent required up to a year's experience before achieving full proficiency. Under ATIS operation, this "journeyman" period has not changed significantly, so an added week or two of training does not make a tremendous difference in the long run.

C.3.4 Updating of Data Base

The MTC's MIS Coordinator indicated that the TIC's greatest benefit was in the area of data base updating. The MTC changes its schedules very frequently (every 4 to 6 weeks) and keeping up with these changes in the manual references was a monumental job. Agents complained that the numerous penciled-in and scratched-out changes eventually made the manual references impossible to read. With centralized updating, a single change to the data file is made accessible simultaneously to all agents. It should be noted that centralized updating proved to be so successful that the MTC eventually did away with the manual references completely. In case of computer breakdowns, which have occurred less than 2% of the time, agents rely on a computer-generated printout of RUCUS data produced by the Scheduling Department. Savings in labor previously spent updating was estimated to total 2300 hours for agents and 1800 hours for supervisory personnel in 1979. When applied to average wage rates, these savings totaled $62,500. As labor rates increase with inflation, future benefits will continue to increase. Supervisory personnel indicated that agents initially rebelled against eliminating manual references, but later admitted that they could work faster without them. Now, on the rare occasions when the TIC is down, agents complain even more volubly about having to use manual references.

C.3.5 Agent Job Satisfaction

Supervisors and agents both stated that implementation of the TIC has led to an improvement in overall working conditions at the Transit Inquiry Center. Only one agent actually left as a result of system implementation.

Learning to use the new telephone equipment and the computer terminals at the same time in many ways forced the agents to pull together and work as a more cohesive group. This cohesion eventually raised center morale. MTC management encourages this cohesive spirit by dividing the agents into three competing "teams". Over a three-month period, the team with the highest overall productivity rating qualifies for cash and merchandise bonuses. The bonus program, according to center management, has been very well received by the agents.

It might be noted in passing that agents generally have high praise for the TIC designers, who actually worked closely with them during system implementation. On the other hand, they have little patience with the telephone system, which has been plagued with numerous problems since its installation. Use of standard Bell headsets with WESCOM equipment sometimes produces unexpected results; one agent described a situation where static electricity generated by walking across a carpet was causing calls to be lost in mid-sentence.

C.3.6 Performance Statistics

As noted above, performance statistics for individual agents, "teams" and the center as a whole are recorded by the WESCOM telephone system and not by the TIC. These statistics are the most comprehensive of any of the three systems evaluated in the UMTA/TSC program. Hourly and daily printouts by the system include data on:

- number of agents available;
- number of calls received;
- number of calls answered;

- actual talk time;
- time "in call work";
- time between calls;
- number of held calls;
- number of calls abandoned;
- frequency distribution of call times;
- percentage of calls handled in 20 seconds or less;
- average speed of answer;
- percent of time all trunks are busy (no access to the system); and
- maximum wait time before agent answer.

According to the Senior System Supervisor, possession by management of such extremely detailed performance information has actually led to smoother system operations. Initially, agents kept running tallies of calls to check against system printouts. When they became satisfied with system accuracy, they realized that agents shirking their responsibilities could easily be detected. As a result, management is able to carry out disciplinary actions more fairly than previously, and union grievances resulting from these actions have actually been reduced. Agents are now more interested in "team" performance scores than in individual statistics.

C.3.7 Interdepartmental/Spinoff Uses

The TIC is a prime example of interdepartmental cooperation at the MTC between the Planning and Scheduling Department, which produces the RUCUS tapes, and the Marketing Department, which operates the Transit Inquiry Center.

Due to the fact that it does not contain a geographic data base, the TIC system is less likely to produce marketable spinoff uses such as ridesharing programs, etc. One potential spinoff use which has yet to be exploited is in the printing of bus schedule data for bus stops and shelters. Such data could easily be generated by the system but as of now is still printed commercially by the Marketing Department.

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